RAILWAY ENGINEERING AND MAINTENANCE OF WAY

BRIDGES - BUILDINGS - CONTRACTING - SIGNALING - TRACK

New Series, Vol. IX
Old Series, Vol. XXVIII | *Chicago* | JANUARY, 1913 | *New York* | No. 1

This Journal has a larger circulation than any other, in the Maintenance of Way Departments of the Railways of the United States and Canada

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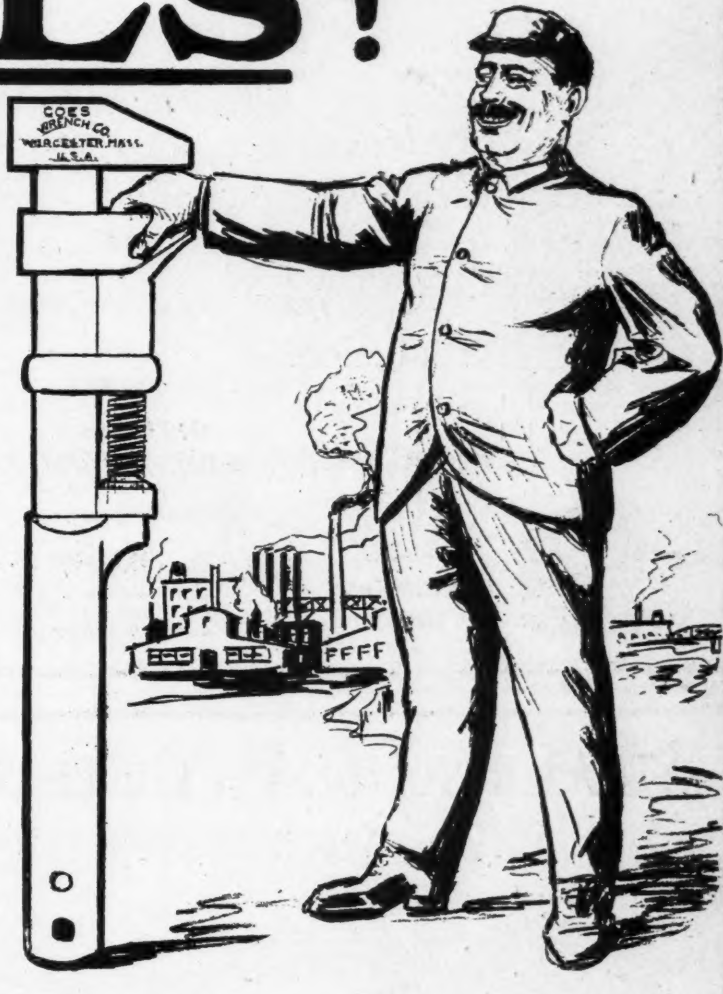

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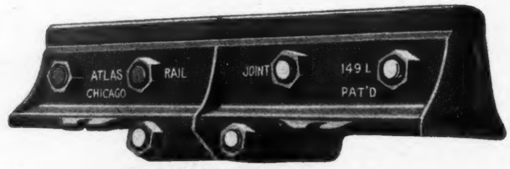

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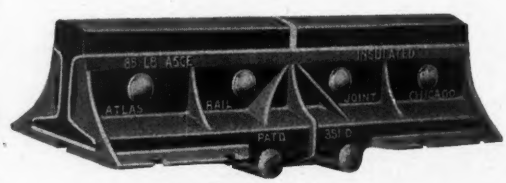

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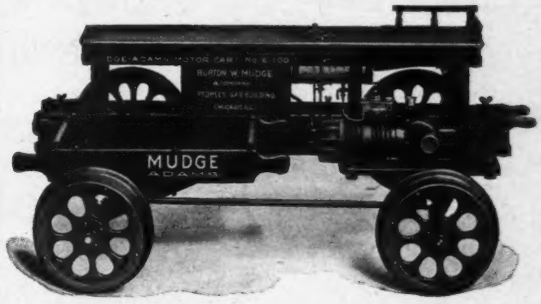

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RAILWAY ENGINEERING AND MAINTENANCE OF WAY

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BRIDGES—BUILDINGS—CONTRACTING—SIGNALING—TRACK
Published by THE RAILWAY LIST COMPANY

WILLIAM E. MAGRAW, Pres. and Treas.
CHAS. S. MYERS, Vice-Pres. LYNDON F. WILSON, Editorial Director
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Contributing Editors: B. W. MEISEL, Signaling. A. M. WOLF, Concrete.

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948
Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765
Central Office: 403 House Bldg., Pittsburgh

A Monthly Railway Journal
Devoted to the interests of railway engineering, maintenance of way, signaling, bridges and buildings.
Communications on any topic suitable to our columns are solicited.
Subscription price, $1.00 a year; to foreign countries, $1.50, free of postage. Single copies, 10 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to the Railway List Company.
Papers should reach subscribers by the twentieth of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

This Publication has the largest paid circulation of any railway journal in the Maintenance of Way field.

Entered as Second-Class Matter April 13, 1905, at the Post Office at Chicago, Illinois, Under the Act of Congress of March 3, 1879.

New Series, Vol. 9
Old Series, Vol. 28 Chicago, January, 1913 No. 1

CONTENTS.

Sawed Ties

IN view of the suggestions that railroads would save a great deal of money and that the country would benefit in receiving a larger proportion of lumber from its forests if sawed ties came into general use, it is well to outline the track man's objections to the sawed tie. It is claimed that a sawed tie can be made out of much poorer timber than a hewn tie; in other words it is impossible to hew a tie out of very knotty or rotten timber. In support of this argument the track man will point to the shorter life of his sawed switch ties in comparison with the ordinary hewn track ties.

Some timber men claim that the cost of sawing the slabs and converting them into lumber, is as great or greater than the price that lumber will sell for. Even if this were not true for the larger timber dealers, who could carry on the work with improved and efficient machinery, it is manifestly true for the farmer and small timber man. And a large percentage of our ties are furnished by the farmer who cannot afford to install a lumber mill for the few dollars revenue he receives from his timber.

For the small tie producer, the sawed tie is out of the question. He can furnish hewn ties, or no ties; and at present it is practically impossible to get anywhere near enough ties from the large timber men. So it is very probable that we will continue to find a goodly percentage of hewn ties among those furnished the railways.

In regard to the sawed ties not being as good timber as the hewn ties, the advocates of the sawed tie will state that the ties accepted will be kept up to grade by the inspector. This is undoubtedly true of some inspectors, and probably untrue of a good many others. The wages which are paid tie inspectors are not, in some cases, high enough to attract and hold good talent for this work. Furthermore such work is considered a "snap," and the job is liable to fall to some favored person who knows little about the work and cares less. These inspectors have to pit their knowledge and experience against the sharpest and shrewdest timber men in the business, men who have spent their entire lives in that business.

The point has been made that the preservative, when treating a tie, is liable to be concentrated in the sides of the tie, and to be very thin in the faces of the tie. This is an excellent point, but only, or primarily at least, for pole ties, and a large number of the hewn ties are not pole ties.

An objection to the hewn tie is that it does not form a uniformly good rail seat, as the sawed tie does, unless adzing is carefully done. This objection can be easily removed however, by the use of the different tie adzing machines and tie adzing tools on the market.

Culverts

THE use of temporary construction in permanent right of way improvement, generally speaking, is to be deprecated. Properly built structures of concrete are superseding those of steel in many applications and permanency has been the object in each case. In right of way improvement particularly, first cost should be and is becoming a subject for secondary consideration

unless it is so high as to be prohibitive. In many instances metal culverts have been placed under high fills in otherwise high grade construction work, supposedly on account of a lower first cost. The metal culvert is specified on the strength of assertions to the effect that they are noncorrosive and not subject to deterioration. If the assertions are true this type of construction offers a method for great simplification of railway construction work. If, however, a few years hence it is found that the metal culverts prove not to possess the qualities of permanency expected, their replacement will be done at considerable outlay above that represented by the primary use of concrete structures. Results of long service will conclude the argument and until such data is available due care should be exercised in specifications for the style of culvert work.

Grand Central Terminal

THE COMPREHENSIVE passenger terminal of the New York Central in New York City is progressing rapidly to completion. When finished, those responsible for the consummation of the plans will be able to point to their work as the greatest railway engineering feat of its kind in the annals. The difficulties which have daily beset the progress of the work from the first, are hardly appreciated even by the experienced construction engineer who has not personally and frequently inspected the job. The principal difficulty, of course, and the one which has given rise to most of the minor difficulties, has been the necessity of taking care of all of the heavy traffic which had already outgrown the old terminal, while the process of wrecking and building has been going on. This has called for a very large amount of temporary construction work. It has also called for frequent shifting of tracks, which includes all that which goes with electrical operation. Even interlocking plants on two levels are included in the large amount of track shifting and relocation work which has been handled with few accidents and few deviations from the systematic arrangement for the disposition of each detail of the whole problem.

This track work and all which goes with it has been under the supervision of C. J. Coon, engineer of the terminal. Under his direction temporary tracks had been laid at a minimum cost consistent with safety of electrical passenger train operation, and permanent track has been laid seemingly without regard to first cost. In the permanent work there is much which would seem to approach experimentation, such as hair-felt pads under tie plates for the purpose of deadening noise, and hydraulic bumping posts designed to stop carelessly handled rolling stock without breakage. Nothing of demonstrated merit which has application in terminal work seems to have been omitted. Upon completion the Grand Central terminal will stand as a monument, not so much to the ability of the designers as to that of the men who have successfully overcome the very great obstacles in the progress of construction.

Appointing Track Foremen

MANY railways make it a practice to pick up transient foremen for extra gang work instead of appointing the more progressive section foremen to these positions.

This policy results in construction gangs being in the charge of men who care little for their positions and who frequently fail to appear on the work, especially after a pay day.

It is just as essential (even more essential) to have thoroughly dependable foremen for extra gangs as to have dependable foremen for section gangs.

Extra gangs are in general much larger than section gangs, and the absence of the foreman is reflected in a reduced production from a larger number of laborers. Such foremen usually figure on getting all they can out of the company, many cases of petty graft being proven against them.

The reason usually urged for appointing transients as extra gang foremen is that they are more experienced in handling large gangs, and also in new track work, and in addition, as mentioned above, there is some reluctance to letting a man leave his section.

The way to meet the first objection is to start appointing the younger and most progressive section foremen to positions as assistant foreman on extra gangs each summer, giving them the necessary experience. And the way to remedy the objection as to leaving the section is for the section foreman to train one of his men to act in his absence. If this idea is constantly kept in mind, and decent wages allowed the straw boss, that objection can be eliminated.

On one large construction job last summer practically the entire supervising force left the service after a pay day, over 400 laborers being on the job. Civil engineers from the different parties were placed in charge of men temporarily, but many of them had had no experience in handling gangs, and the laborers soon found this out.

Changing foremen usually spoils a gang, especially if changes are frequent. It would be a great advantage to the construction forces if steady and experienced men from the maintenance of way department were available as extra gang foreman.

Some railways, however, have gotten to a point where almost any man will answer for a section foreman; also many men are put in charge of sections who know less than the laborers they are working. This is bad practice from the standpoint of the laborer and from the standpoint of proper maintenance.

The logical solution has been suggested by many maintenance of way men, i. e., appoint students as apprentice foremen in section gangs and pay especial attention to the education of such men. Also pay wages high enough to make it an object to such a man to stay in the service.

Last, but not least, never appoint an outsider to a position until there is satisfactory evidence that there is no employe in the service fitted to hold the vacant position.

The Arizona Eastern, it is stated, will construct a steel bridge across the Salt river at Temple, Ariz. The structure will cost approximately $150,000.

The Atchison, Topeka & Santa Fe and the city of Dallas, Tex., it is reported, will jointly construct a reinforced concrete bridge across Merlin street in Dallas, Tex. It will cost about $85,000 and will be 800 ft. long.

Work has commenced on the construction of a union passenger station at Vincennes, Ind., for the Baltimore & Ohio Southwestern, the Big Four, the Chicago & Eastern Illinois, and the Vandalia.

The Canadian Northern has been authorized to construct a bridge across Sanguinet street in Montreal by means of an overhead structure. This company also proposes to spend $2,500,000 on new terminals at Port Mann, B. C., which will include 60 miles of freight yard tracks, extensive repair shops, a 20-stall roundhouse, freight sheds and several smaller buildings.

The Canadian Pacific has nearly completed the double tracking of the St. Lawrence, or Lachine bridge, at Highlands, near Montreal. This bridge has been in course of construction for nearly two years and has cost over $2,000,000.

RAILWAY ENGINEERING AND MAINTENANCE OF WAY

Enlarging the Galesburg Tie Plant

The Galesburg plant was first put in operation in December, 1907, and an addition has recently been made which nearly doubles the capacity of the plant.

The old installation† consisted of three cylinders, each 132 ft. long and 6 ft. 2 ins. in diameter with a capacity of 700 ties. The old yard contained 4 tracks about 4,000 ft. long. The area covered by the buildings and tie yard was about 80 acres.

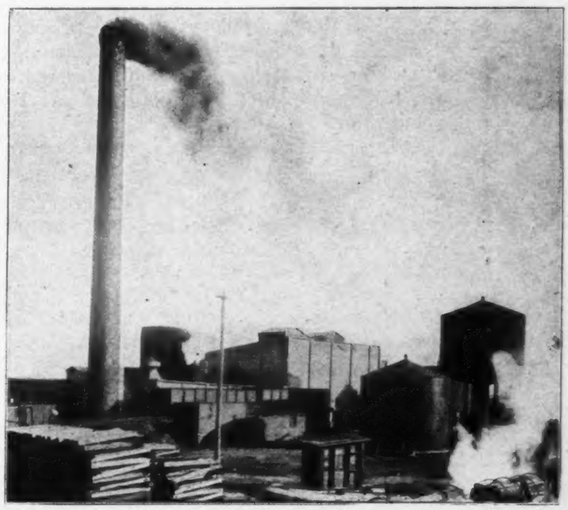
The total area available for the plant was 95 acres, and the engenious track layout* shown on the accompanying plan, uses nearly every available square foot of the ground. On this plan it will be noted that the ladder track is nearly at right angles with the material tracks. The ladder lays parallel and close to the right of way line of the territory owned, which lays along side a public road. This location of the ladder does not leave a triangular unusable space back of it, as a ladder would which was laid out with no curves behind the frogs.

The frogs are all standard No. 7, and the maximum curve is 16°. There are a large number of curves in the yard, but this is not as great an objection as would first appear. In a freight yard where hundreds of cars are switched over the tracks daily, such curvature is highly undesirable from the standpoint of maintenance and operation. But where only one or possibly two strings of cars are moved over these curves each day, it will readily be seen that there will be little extra maintenance work. It is assumed that no more than 20 or 25 cars will be handled in each train, which is about all that it is necessary to switch at once in a tie plant yard. A small engine is used for switching, which is of course much easier on the curves and track than the large switch engines used in freight yards.
all the tracks, but number 6 leading off directly from the ladder. Track 6 connects up with number 7 a short distance behind the frog. The ladder track on the opposite end is located on an easy curve. This ladder is separate and independent of any main or side tracks. This layout prevents any interference with engines not at work in the material yard. The ladder on the east ends in a stub track, which is long enough for thirty cars. Having ladder tracks on either end makes it easy to place and take out a few cars at a time as the unloading progresses. This feature not only facilitates the engine and car movements, but makes it possible to keep the tie unloading gangs always fully supplied with cars, and there is no chance for delay on that score unless ties are not shipped in fast enough. The running track is kept clear at all times, and provides plenty of communication between the two ladders.

Ties are unloaded, starting on the car nearest the ladder and working away from it. All empty cars are thus easily accessible and a few can be pulled out from time to time.

The ladders crossing over to the retort tracks are three rail tracks. These are used to shove the loaded trains up to the cylinders, where they are within reach of the cable and hoist which pulls them into the retorts. A standard gage switch engine pushes these cars up through these ladders, therefore a three rail track is necessary. Loading tracks are three rail for the same reason.

The new additions to the plant building are indicated on the diagram herewith. The retort room was doubled in size, the addition being 38 ft. x 152 ft. Ample provision for expansion had been allowed in the original plans, and so the whole plan now harmonizes. The boiler room was extended 22 ft. 6 ins. east, which gives sufficient room for three additional boilers, only two of which have been installed at present.



General View of Galesburg Tie Plant.

The building is a reinforced concrete column and girder structure. In making the addition to the north, four panels of the old wall were removed, two in the center and one at each end. The old columns were located in the wall, and projected several inches inside. These columns were left undisturbed and the curtain walls were taken out as in-

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*The ladder track is perfectly straight on the east end, described on page 487, November, 1911, issue of *Railway Engineering*.

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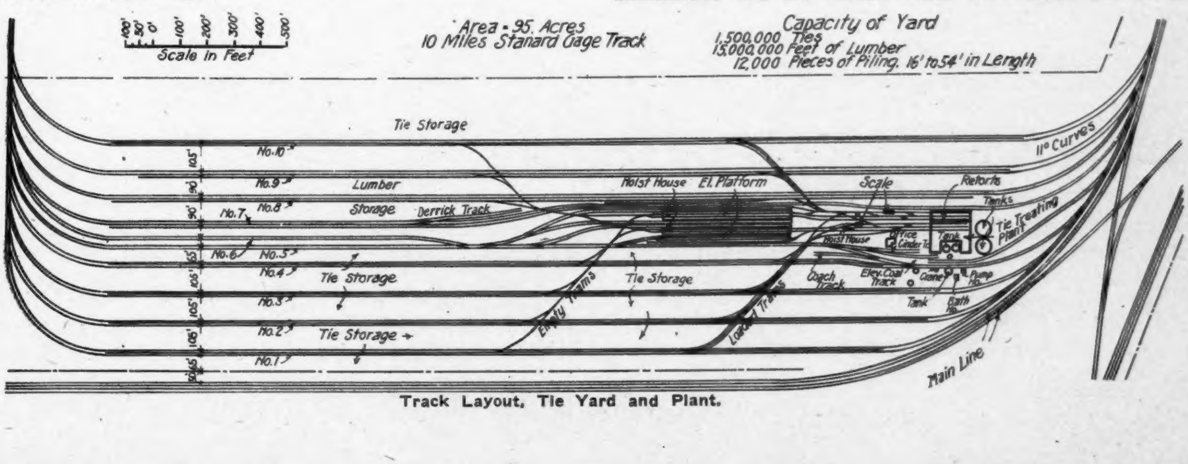
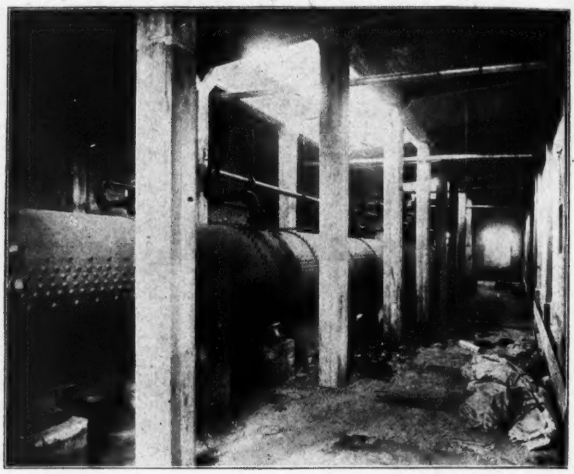
*This layout is practically the same as suggested by J. H. Waterman at the convention of the Wood Preservers' Association, January, 1912.



Track Layout, Tie Yard and Plant.


West End of Tie Yard Showing Ladder Track.


Interior View of Tie Plant Building, Showing Concrete Column and Girder Construction.

dicated. The old building is shown dotted on the plan reproduced herewith.

Two new 150 H. P. boilers have been installed, and a third boiler is to be installed when the third new retort is put in. The opening into this addition was made in the same manner as the one on the north side, by taking out several of the concrete wall panels.

The present retort room is 76 ft. wide by 152 ft. long and about 10 ft. high. The roof slopes toward the center, as shown on one of the illustrations. The low point or trough in the roof is located just above the old exterior wall, which is now the center wall in the retort room. This construction allowed the height of roof at the outer part of the building to be made the same as the opposite side of old retort room. The roof is thus made plenty high enough and the symmetrical roof slopes and adds to the appearance of the structure. The building gives a rather pleasing and exceptionally clean appearance, although of course it was designed for utility and not for architectural effect. Concrete is especially fitted for use in tie treating plants, because it is easily kept clean, is nearly impermeable if properly constructed and is also practically fireproof.

The general construction of the building shows very plainly in one of the illustrations. A typical center column rests on a concrete footing 3 ft. square, and 12 in. deep. The top of the footing slab is 1 ft. 10 in. below the floor line. The footing is reinforced in both directions by ¾-in. corrugated square bars, spaced on 9-in. centers. The bars are placed 2 in. above the bottom of the concrete. The footing only projects 6 in. beyond the column pier on each side, and the reinforcement is ample to take care of ordinary stresses, and also probably any other stresses liable to be set up by unequal pressure, or unequal bearing resistance of the soil.

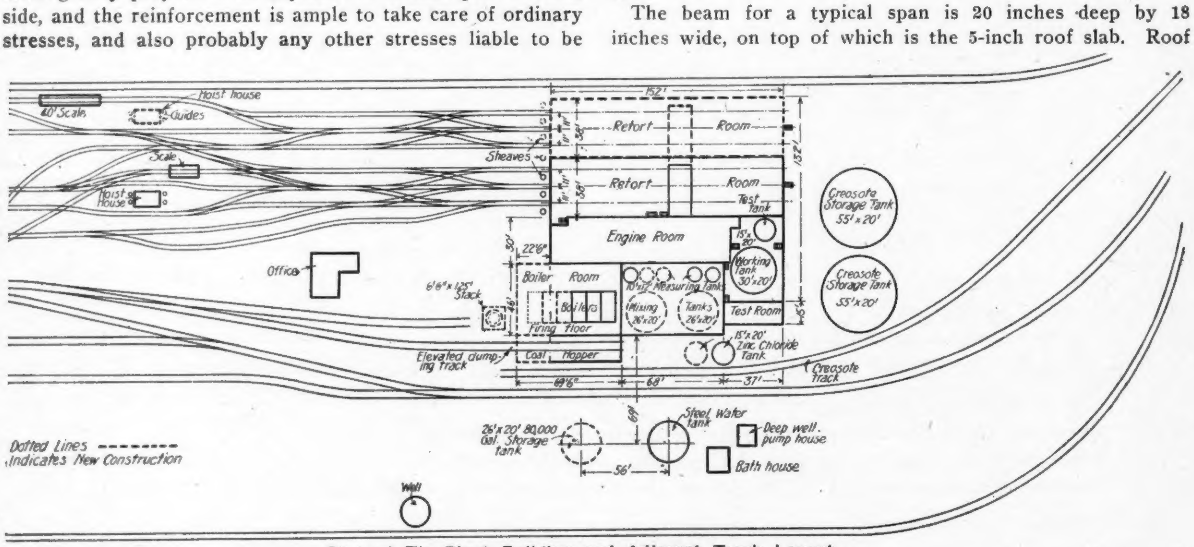
The column is 18 inches square from 2 inches above the floor to 12 inches below the roof slab. Beginning 2 inches above the floor, the column pier spreads out to a 2-foot square at the floor line. This short slope has a tendency to protect the main part of column by warding off heavy objects being wheeled or dragged along the floor. The pier is 2-foot square below the floor line to the footing. Its total depth is 2 feet, running up to 2 inches above the floor line.

The columns in the center of the building are reinforced by 8 bars placed with centers 2 inches from the column faces, all spaced on 7-inch centers. The reinforcing bars are ¾-inch corrugated square bars wired together every 12 inches by soft iron wire. The center bars project 12 inches into the piers.

The bars extend up through the girder into the roof slab. In the wall columns the two center reinforcing bars, within the wall lines, are omitted.

At the top of this column, there is a fillet, which widens out 12 inches, in a height of 12 inches. In the fillet are located four shear bars placed 2½ inches from the inclined surface. The bars are ¾-inch corrugated, 2 ft. 9 inches long, and they were tied to the bends in the beam reinforcing bars.

The beam for a typical span is 20 inches deep by 18 inches wide, on top of which is the 5-inch roof slab. Roof



Plan of Tie Plant Building and Adjacent Track Layout.

slab and beams were poured in one operation, with no construction joint between. Two inches from the bottom of the beam are four ¾-inch corrugated bars, spaced on 3-inch centers, the outer ones being 4½ inches from the face of the beam. Stirrups loop under these bars and up into the roof slabs, to take care of the shear stresses. Above the columns two of the bars are bent up, ending a few inches beyond the outside column line. Two bars are bent up and end at a point about 2 feet from the column. The column shear bars were wired to this bend, as were also three bars in the top of the beam. The latter are ¾-inch corrugated bars 2 inches from the top of the beam, to take care of the tension over the column.

At the center of the building two panels and one column are omitted, forming the opening between the old retort room and the machine shop.

The columns supporting the roof over this opening, were reinforced with the same number of bars, also placed in the same manner as the column already described. The column is 20 inches square, however, instead of 18 inches, and at the top has a fillet 18 x 18 inches, instead of 12 x 12 inches. The shear bars, three in number, are 3 feet 6 inches long.

The beam for this span is 36 inches deep. At the bottom are seven ¾ inch corrugated bars, in two rows. The lower row is 3 inches from the bottom of the beam and contains 4 bars on 3⅜ and 3¼-inch centers. The second row of 3 bars is 3 inches above that, the bars being staggered between the lower bars. The tension bars, there are four over these columns, are longer for this span, four of the bottom bars being bent up and tieing the four tension bars in place, the latter being ¾-inch square corrugated.

The roof slab is 5 inches thick, and is waterproofed with ceresit. The reinforcing of the slabs consists of ½-inch corrugated bars on 6-inch centers for the long span of the slab, and ½-inch bars on 12-inch centers for the short span. The lower bars are 1 inch above the bottom of the slab, and the upper rods were wired fast to them.

The two skylights in the new section of the retort room are plainly seen in one of the illustrations. The old half of the retort room has two of similar design. Each skylight has 22 windows, and these furnish a very good light.

On the west side of the plant in the new retort addition, there is a large door opening at car floor level. This door is to be used for loading or unloading machinery or material into or from cars.

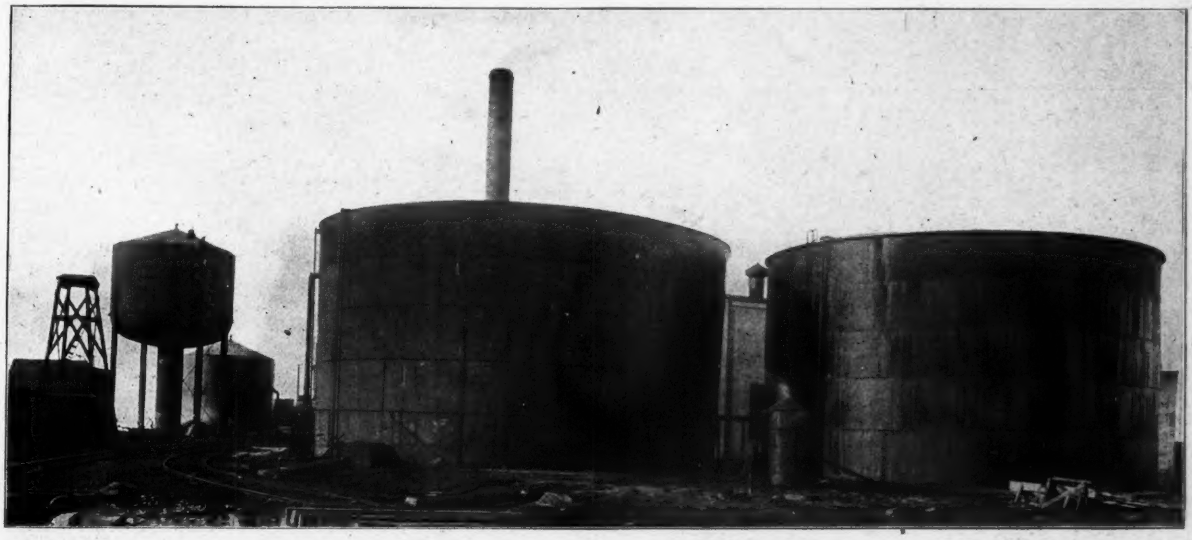
The curtain walls are 6 inches thick with ½ inch corrugated horizontal bars on each side, ½ inch from surface, spaced on 12 inch centers.

The chimney which appears in the illustration is a new one, of the Wiederholdt type. It is a combination reinforced concrete and tile chimney, the tile appearing on the exterior and interior and being filled with concrete. The tiles are made with exterior and interior vertical faces 1 inch thick, curved to the proper radius for the chimney. A single vertical web member is located at the center of these two exterior faces. When making the tile, they are placed in molds which form three vertical webs, one at the center and one at each end; this simplifies the manufacture. After the tiles are delivered, the outside web members are broken out along marked lines, with a trowel, leaving a short projection which helps to give a bond with the concrete. The interior faces of these tile are corrugated, this also to give a better bond between the concrete and tile. The upper part of the center web of the tile curves downward, allowing a space for the horizontal rods, and supports them while the concrete is being placed.

The objects of this construction are to eliminate forms for the concrete, and to place a hard burned fireclay tile in exposure to the smoke and heat, instead of the concrete. It also provides support for the horizontal reinforcing and allows it to be placed one ring at a time. The concrete is placed quite dry, and can be well tamped because put in in small lifts.

The first course of tile is laid on a bed of cement mortar on the foundation, the tiles being placed between the vertical projecting rods. After the course has been laid it is partially filled with 1 to 3 sand concrete, fairly dry, and tamped well into place. The horizontal reinforcing rod is then placed, and the remainder of the tile filled with concrete and tamped. Upon this bed of tile and concrete a layer of cement mortar is spread and the next course is laid to break joints with the preceding course, after which the operation of filling is repeated.

The foundation is of 1:3:5 concrete 4 feet thick and 20 feet square at the bottom. There are 2-foot offsets 3 feet above the bottom, and 4 feet above the bottom, which brings the top down to a 12-foot square. The foundation is reinforced with horizontal bars in both directions, on 13-inch centers, placed 1-inch above the bottom. The weight of the foundation is approximately 240,000 lbs. A wind pressure for a velocity of 100 miles per hour was assumed in design.



Rear View of Plant, Showing Storage Tanks.

The chimney is 130 feet high, has an exterior diameter of 10 feet 6½ inches at the bottom and 7 feet 10 inches at the top. The thickness of the chimney from base to one-half of height is 10 inches. The thickness of the remainder of the chimney is 8 inches. The inside diameters are 8 feet 10½ inches at the bottom and 6 feet 6 inches at the top. The exterior has a batter of ⅛ inch to 1 foot.

The vertical rods are spaced on 11-inch centers from top to bottom, the bars toward the bottom being larger to take care of the greater stresses. The first 40 feet above foundations the vertical reinforcing is 1 inch square twisted bars. These bars run clear down through the footing. The second 40 feet is reinforced vertically with ¾-inch square twisted bars, and the remaining 50 feet is reinforced vertically with ½ inch square twisted bars. The bars lap a sufficient distance to make a good splice.

The horizontal reinforcing from the foundation up to a height of 65 feet (one-half the total height) consists of ½ inch square twisted, horizontal rings on 9-inch centers. The upper 65 feet has ½ inch square twisted horizontal rings also, but they are spaced on 18-inch centers. The centers between the horizontal rings in the upper portion, it will be noted, are just twice the spacing of the lower horizontal rings. Thus the same size tile were used throughout, but horizontal bars were omitted in every other joint at the top.

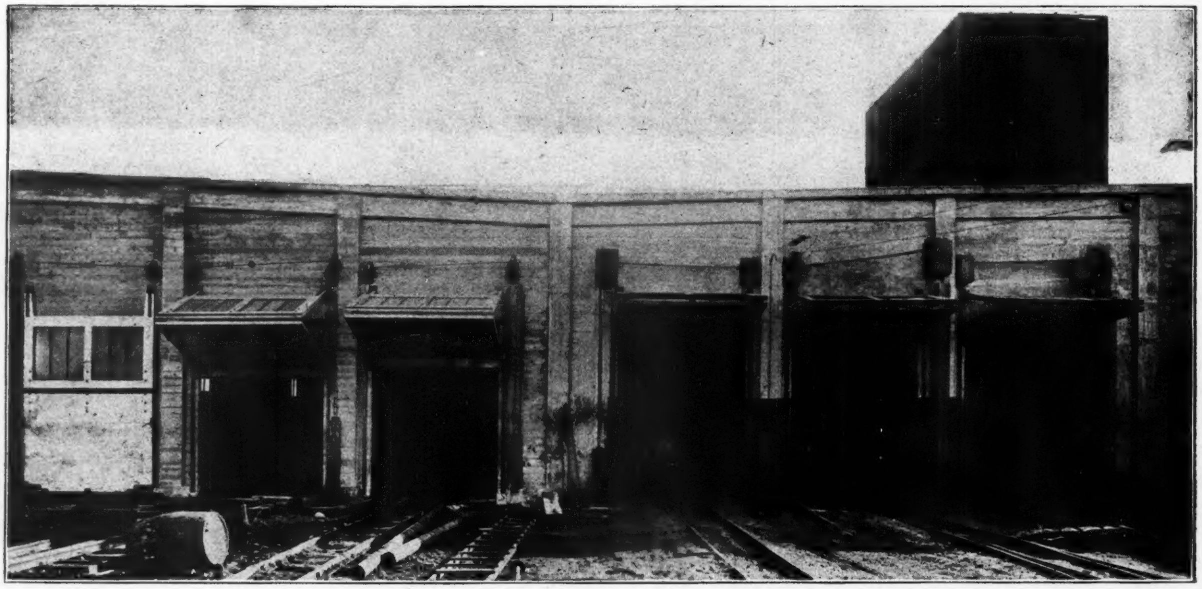
The vertical reinforcing was placed practically in the center of the chimney wall, with the horizontal rings outside. The chimney was designed and constructed by the Wiederholdt Construction Co., of St. Louis.

The present addition to the plant building provides room for three retorts, only two of which have been installed. The foundations for the third one are in place, and its installation will be a simple matter when the demands on the plant necessitate still another cylinder. The new retorts are of ⅞-inch metal, 132 feet by 6 feet 2 inches, the same dimensions as the old ones. The new cylinders are double ended, that is to say, they have swinging doors on each end. It is not proposed to run trains into the cylinder from both ends, but the double end doors are expected to greatly facilitate matters if anything breaks down inside the retorts. In that case both ends of the retorts may be opened, and part of the charge drawn out in each direction. The old retorts have entrance only at one end, and in case of a break down inside of them, it was necessary to open them up and let them cool down before the entire charge could be removed, and cooling off required nearly half a day. The old retorts were on 11-foot centers, with the centers of the side retorts 8 feet from the wall. The new retorts are located in the same manner.

The new retorts have 3-inch cast iron steam coils, and all piping from the working tanks to the retorts is cast iron. The circulating lines leading from the pump to the retort, the radiators in the retort, and in fact all the metal of the new installation which is to come in contact with the preservative is to be cast iron. The Card process is being used, and the zinc chloride in the solution, it has been well proven, rapidly eats out steel and wrought iron.

A 3-inch heat insulating lagging is to be placed on the new retorts. All piping, as far as possible, is underground in frost-proof square conduits, covered with concrete slabs outside the building, and with iron plates inside the building.

A new Ball engine has been installed, connected to a General Electric direct-current generator, which furnishes a 400 amp., 225 to 250-volt current. Electricity is used for lighting, and also for power for the hoist engines which pull trains into and out of the retorts.



Six Retort Door Openings, Cylinder Where Door Is Closed Has Not Been Installed.

The following is a list of the new equipment installed:

Two new retorts, 132 feet by 6 feet 2 inches by ⅞ inches.

One Blake dry vacuum pump.

One Blake & Knowles steam pump, 10x22x18 inches.

Two Knowles duplex pressure pumps, 7½x4½x10 inches.

Two steel working tanks of 80,000 gallons capacity each.

Two measuring tanks, capacity 10,000 gallons each.

One zinc chloride storage tank, capacity 36,000 gallons.

Two Yoemans Bros. centrifugal circulating pumps with motors attached.

Two 150 H. P. boilers, Frost Mfg. Co., Galesburg.

One No. 8 Stillwell feed water heater manufactured by the Platt Iron Works, Dayton, O., taking care of all condensation.

One feed water pump.

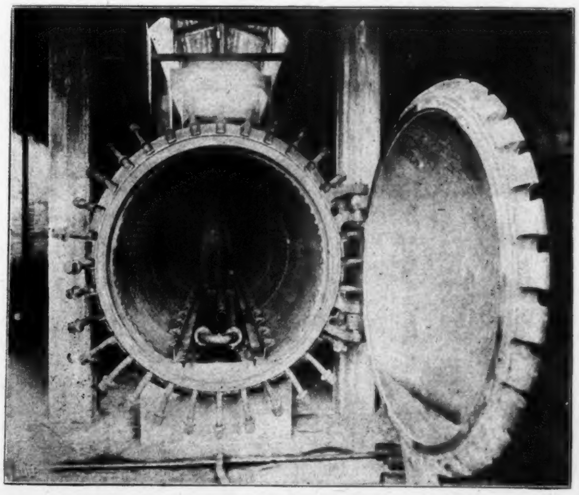
One shallow well pump 12x8½x12 inches.

The new working and measuring tanks are equipped with cast iron radiators manufactured by the American Radiator

Co. The old radiators were wrought iron and liable to attack by the emulsion. Two old wooden measuring tanks were replaced by the tanks mentioned, and the tank room was roofed over to protect the tanks and keep them warm in the winter, as well as to protect the employes in stormy or cold weather. This room has two skylights in the roof ventilator, each with fourteen windows.

The whole plant is heated by steam radiator pipes, running along the walls of the buildings.

A new well was dug to furnish water for the plant, as water from the old well was hard and caused some trouble. The well was dug down 30 feet, with a 20-foot diameter, without striking water. A pit, with a 4-foot diameter, was then dug down for 13 feet, where quick sand and water were encountered. An 8-inch strainer was then sunk 16 feet further, and gave a good supply of water. It was found on investigation that there was an underground current from the northwest to the southeast, so two 12-inch strainers were also sunk. This well supplies all the water nec-



One of the New Retorts.

essary for operating the plant, and also about 50,000 gallons per day for the engines. The pump is located 30 feet below the ground in the shallow well.

Comments.

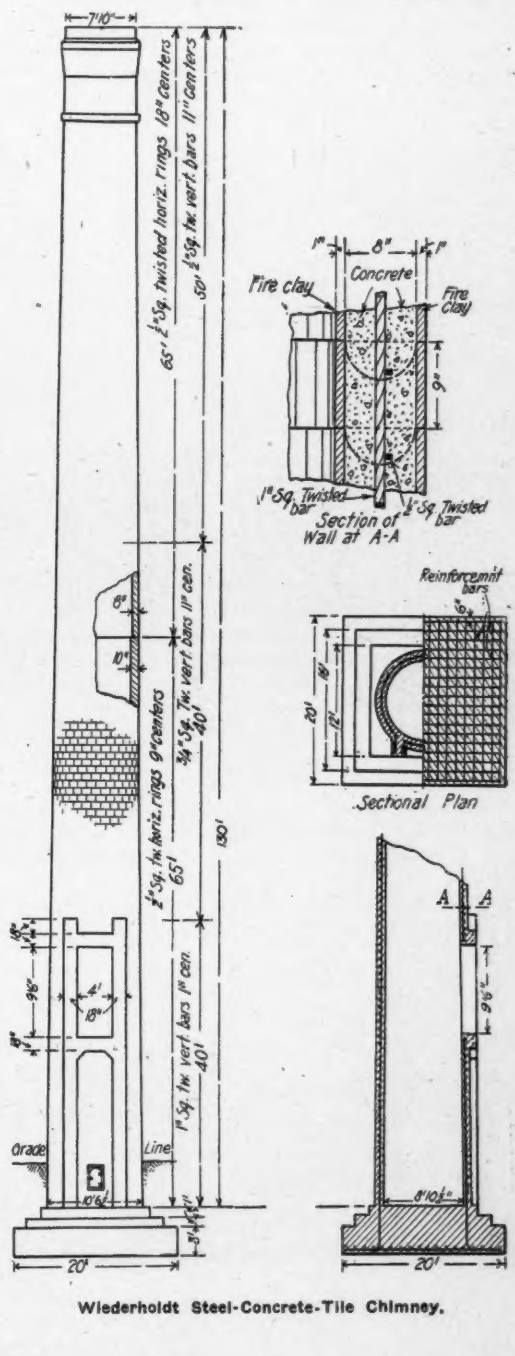
There have recently been shipped to the plant two specimen ties from one of the Chicago, Burlington & Quincy Railroad's numerous experimental tie sections. One of these is a red oak which was recently taken out of the track at Mystic, Wyo., after having been in track for 12 years. This tie was treated with zinc chloride at Edgemont, S. Dak., and placed in track with Goldie claw plates. The tie is perfectly sound and looks good for several years more life. The other tie is a pine which had a similar treatment, and aside from mechanical wear this tie is also sound.

The plant has recently started to separate ties into classes 1, 2 and 3. Number 1 ties are first class ties of large size and best timber for use in main lines; Number 2 ties are for use in branch lines; and Number 3 ties are for use in side tracks. This is a refinement attempted by no other plant, we believe.

The laborers are foreigners, and are paid on a piece-work basis, so that this extra sorting costs nothing. The man loading Number 1 ties fills his train, rejecting all but first class ties. Next a man follows along loading Number 2 ties, and a third loading Number 3 ties. As far as possible each laborer is kept loading the same kind of ties all the time. Although this system has not been in operation very long, the laborers have fully grasped the idea, as any one can plainly see by walking along the loading track, examining the ties and asking each man what class he is loading. This classification is in addition to the A, B, C classification for species described in November, 1911, issue of *Railway Engineering.*

The plant is being run at high efficiency. In 1911 the retorts were performing operations for nearly 97 per cent of the total working time, 24 hours per day for six days per week. The last year the delays have been cut down to still less and will run between 1 and 2 per cent. Even a casual inspection of the plant shows that the work is highly organized and well disciplined, which, with the large yard and track layout, accounts for the high efficiency attained.

The yard is loaded and unloaded in rotation. One of the photographs shows this very plainly, the space between two tracks being entirely devoid of tie piles, the next track being also nearly cleaned out. The photographs show all other parts of the yard practically filled to capacity.



Wiederholdt Steel-Concrete-Tile Chimney.

View of Tie Yard From West, Plant Building in the Distance.

The old plant was not closed down while making the additions, but was kept working at full capacity.

We are indebted for the information and plans herein shown to J. H. Waterman, supervisor of timber preservation; August Meyer, supervisor of tie plant, and W. T. Krausch, engineer of buildings of the Chicago, Burlington & Quincy Railroad.

The Elk & Little Kanawha is said to be considering the construction of an extension from Shock to Russett, a distance of about 12 miles. The road has recently completed 27 miles of railroad from Shock to Gassaway, W. Va.

The Hocking Valley has awarded a contract to John Lindsey, Pomeroy, Ohio, to build a spur track from Kerr's Run through Nearse Settlement, a distance of about 12 miles.

The Intercolonial has finished work on eight miles of new line in the province of New Brunswick from Nelson to a point two miles east of Chatham to replace the old line between these two places. Work is now under way between Georges River and Sydney Mines.

The Laurel Fork has work now under way for an extension from Frog Level, Tenn., to Laban, 3 miles.

The Louisville & Nashville, it is reported, will immediately begin operation on its extension from Jackson to McRoberts, Ky., a distance of about 105 miles.

The Nevada, Lebanon & Eastern has been incorporated in Missouri with $1,000,000 capital, to build a line from Nevada, Mo., east via Stockton, Bolivar, Polk and Buffalo, to Lebanon, 100 miles. The stockholders include: J. A. Daly and S. A. Wright, Nevada; R. A. Brown, C. W. Vilas, J. B. O'Bannon and S. J. and W. A. Thompson.

The Oberlin, Hampton & Eastern will build a 4-mile extension south to Elton, La, also a 16-mile extension northeast towards Pine Prairie.

The Pacific & Eastern it is said will construct an extension that will give freight and passenger connections with the Chicago, Milwaukee & Puget Sound. The work will cost about $1,000,000.

The Union Pacific has work now under way on the line from Gering, Neb., west towards Medicine Bow, Wyo. The Kilpatrick Brothers & Collins Contracting Co. have the contract. Work is also under way laying second track from Herdon, Neb., to Dix, 14.28 miles, and from Kimball, Neb., to Pine Bluffs, 21.04 miles.

The Washington & Great Falls Railway has work under way on a 10-mile line west from Bethesda, Md. There will be a 50 ft. bridge, also a 40 ft. bridge and 5 other smaller bridges. Track has been laid on 2½ miles. The Pittsburgh Construction & Supply Co., Washington, D. C., has the contract.

The Anthony & Northern, Anthony, Kan., has incorporated under the laws of the state of Kansas to construct a railroad from Anthony to Hastings, Neb., a distance of about 300 miles.

The Atchison, Topeka & Santa Fe will reconstruct its line from Havana, Okla., to Tulsa, Okla.

The Atlantic, Okeechobee & Gulf, it is said, has completed financial arrangements and will begin the construction of its line from Tampa to Fort Lauderdale, Fla.

The Cary North & South is having surveys made for the construction of a line from Cary to Toomsboro, Ga., 29 miles.

The Chicago, Milwaukee & St. Paul has awarded the contract to Morris, Shepard & Dougherty, St. Paul, Minn., for laying a second main track and grade and alignment revision between Milan, Minn., and Millbank, S. D.

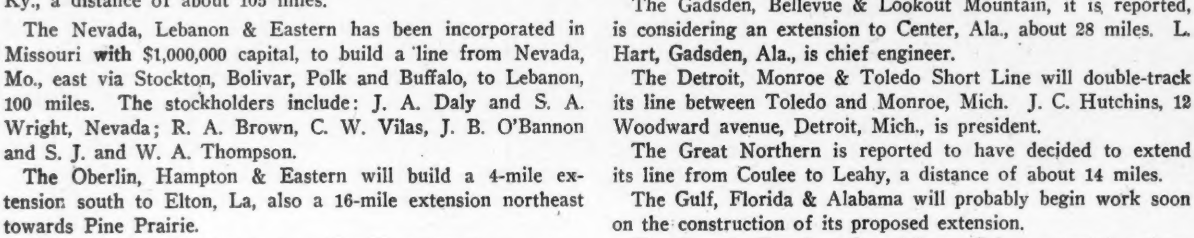
The Gadsden, Bellevue & Lookout Mountain, it is reported, is considering an extension to Center, Ala., about 28 miles. L. Hart, Gadsden, Ala., is chief engineer.

The Detroit, Monroe & Toledo Short Line will double-track its line between Toledo and Monroe, Mich. J. C. Hutchins, 12 Woodward avenue, Detroit, Mich., is president.

The Great Northern is reported to have decided to extend its line from Coulee to Leahy, a distance of about 14 miles.

The Gulf, Florida & Alabama will probably begin work soon on the construction of its proposed extension.

The Georgia Terminus Ry., Athens, Ga., is reported to have made application for a charter to build a railroad connecting the Central Ry. of Georgia and the Seaboard Air Line tracks in Athens. The road will also build several spurs for manufacturers' service in Athens. T. K. Scott and H. H. Dean, it is reported, are interested. The capital stock is $25,000.



View of the Yard from East.

PANAMA R. R. RELOCATION.*

Report of Lieut. F. Mears.

Original Relocated Line.

At the beginning of the year construction work on the Panama R. R. was confined to the Gatun valley section of the line—Gatun to Monte Lirio—and consisted in completing the immense embankment in the Quebrancha, Brazos, and Baja Bottoms, which have been under construction since January, 1910.

The embankment across the Brazos Bottom, 4,800 feet long, is the largest on the line. While the elevation of the track is the same, the fill itself not so high as some of the other large embankments in the same district, the natural ground level being at a higher elevation. For this reason there was less weight per square foot and it was thought the Brazos Bottom might hold up without settlement. Diamond drill borings had shown the underlying strata of the Brazos Valley to be about the same as the Quebrancha, i. e., solid rock from 150 to 200 feet below the surface of the ground. The intervening material consisted of a top or ground layer of fairly good clay, from 20 to 30 feet thick, with an underlying stratum of soft clay, mixed with decomposed wood and vegetable matter, and a small proportion of fine sand. This soft layer varied from 50 to 100 feet thick. The pressure on this top layer caused this softer mass to move toward the line of least resistance, upheaving the natural ground beyond the toe of slope.

All of these settlements were treated by spreading the base of the fill, in order to counterweight the natural ground and thus prevent upheaval, and also to decrease the weight per square foot upon the natural ground.

The Brazos Bottom fill was nearly completed when the first settlement occurred. (The base of the fill was at that time spread out for a 40-foot roadbed, and side slopes of 1 on 2.) The base was then widened to slope stakes set at 1 on 3 before any further weight was added to the upper level, and when completed there was found to be no further difficulty in bringing the top level to grade.

Some further trouble with settlements was encountered with the Quebrancha fill, and also with the Baja fill, but they were fought and conquered on similar lines as described above, it being necessary in these cases to spread the base to a 4 on 1 slope on account of the greater height of fill. It is not to be expected that posterity will generally realize the great amount of yardage necessary to build this short 3-mile section of line through the Gatun Valley. In these 3 miles there have been placed 4,736,072 cubic yards of material, or an average of 1,578,690 cubic yards per mile, all necessary to secure a permanent railroad above the proposed lake level.

These embankments were practically completed by January 1, 1912, but two steam shovels were retained for several weeks to furnish material for riprapping fills, and the last steam shovel was cut out on February 14, 1912.

Gold Hill Line, Panama R. R., Looking South Across Deep Valley, East of Paraiso.

The work of laying the remaining permanent track was undertaken in December, 1911, and completed, as far as practicable, by February 15, 1912. This track consisted of 90-pound open-hearth steel, 100 per cent joints, and either creosoted or hardwood crossties, fitted with Economy tie plates and screw spikes. The screw spikes in hardwood ties were put down with a machine driver, while with the creosoted crossties both the machine driver and hand wrenches were used. This track was ballasted with gravel obtained from deposits in the Chagres River.

This section of the line was formally turned over to the Panama Railroad Company on February 15, 1912, on which date the entire operation of the road was transferred from the old to the new line. The trains operate over this new line east of the canal as far as the north end of Culebra Cut, at which point they switch back across the canal on a construction dike to the old main line, following it north to Gorgona, whence they take the original direction south, over the old route, to Panama. The operation over the new roadbed has been attended with no difficulties, except that in some cases some small slides have occurred along the

*From the annual report of the Isthmian Canal Commission.

slopes of the embankments. The work of rip-rapping the submerged embankments has continued under operation, and the weight of the rock placed as rip-rap has sometimes caused the sides of the fill to slide, necessitating careful work to maintain traffic.

New Gold Hill Line.

The so-called Gold Hill Line is 9⅜ miles in length from the south end of the Chagres River bridge to the junction with operated line at Pedro Miguel. It leaves the 95-ft. east berm of the Culebra Cut just south of the bridge and passes around Gold Hill on a high level. The summit is reached near the La Pita divide at +271 above mean sea level, and the Continental Divide is crossed, opposite Culebra, at an elevation of +241 above mean sea level. This line was well under construction at the beginning of the fiscal year and the work progressed to completion in the early part of 1912. The construction of the section of the line immediately east of Gold Hill, along the Pedro Miguel River to Paraiso, was attended with considerable difficulty in the way of slides. The rock strata, inclined toward the river bed, coupled with the soft, moisture-laden ground soil, caused several of the embankments to slide. It was found impossible to build up a stable railroad embankment at one of these points, and the alignment was therefore shifted toward the hill, and the roadbed placed entirely on solid ground. The grading on this line was completed in the month of March, 1912, and construction of permanent track in May, 1912. The line was formally turned over to the Panama Railroad Co. by the Isthmian Canal Commission on May 25, 1912, and accepted, which transaction completed the delivery of a new railroad, entirely on the east side of the canal, to replace that part of the old Panama Railroad destroyed (or to be destroyed) by canal operations.

Gold Hill Line Looking North Up Pedro Miguel Valley.

The St. Louis & San Francisco, it is said, has ordered 900 tons of bridge steel from the McClintic-Marshall Construction Co.

NORFOLK UNION STATION.

The new Norfolk terminal has recently been completed by the Norfolk Terminal Ry., which company is controlled by the Norfolk & Western Ry., the Norfolk Southern R. R. and the Virginian Ry. The work was started July 1, 1911, and was required by the contract to be ready for occupancy in ten months. The offices were completed and occupied in nine months.

The new Union station is located at Main street and Archer's lane. The station has a main floor, a mezzanine floor and seven office stories, the lower floor being used as a station and the six upper floors as railway offices. The building is of structural steel, with dense, hard-burned red brick exterior, 198 ft. long and 104 ft. 6 in. wide. The tracks are practically at street level, as is also the station floor. The lower floor is divided up into a main waiting room, colored waiting room, men's smoking room, women's waiting room, news stand, ticket and telegraph offices and station master's office.

The main waiting room is 40 ft. by 129 ft., with a ceiling height of 27 ft., with a terazzo floor. This room has marble pilasters and wainscoting five feet high of green-veined marble from Rutland, Vt. The walls and ceiling are of ornamental plaster, as shown in one of the photographs. The finish of the entrance and lobby is the same as that of the main waiting room. The windows are plate glass, with quarter-sawed oak window trim.

The women's waiting room is 24 ft. by 44 ft., has a terazzo floor on marble base and wood wainscoting. The colored waiting room is 46 ft. by 53 ft., with marble wainscoting and terazzo floor. The men's smoking room is 20 ft. 8 in. by 27 ft. and is finished in the same manner as the main waiting room. The shelves and counters in the news stand, ticket and telegraph offices are of gray Knoxville marble.

The main entrance is on Main street and opens up into the lobby. On the right are the ticket offices, and on the left are the men's waiting room and the parcel check room

and news stand. On Archer lane is a carriage porch of ample size, opening directly into the main waiting room. On the northwest side of the building is an alcove 10 ft. by 100 ft., opening out onto the concourse through a series of double doors.

The station is a terminal; that is, the tracks end at the station building. The shelter sheds are of the umbrella type, with columns in the centers of the platforms. At the west side of the concourse is the baggage room. There are two entrances to the baggage room from the main waiting room and one from the concourse.

Piling was driven under all foundations, including piers for the main building and also under the baggage and express building, the power station and chimney, as well as under the columns of the shelter sheds.

The concrete for footings, piers and foundation walls was was required to be clean, coarse and sharp, and free from loam, clay or vegetable matter.

Some cinder concrete was used on the work, and the specifications for cinder concrete were also very rigid. Cinders were required to be clean, well crushed and well screened from hard coal or slag, and were required to pass a one-inch screen. The inspector had power to order cinders to be screened and washed down in case they did not meet with approval.

The forms for foundations were made up of 1-in. lumber, and 2-in. lumber was used in the walls. Forms were left on the concrete for 14 days after the concrete was placed.

The floor of the main waiting room is of 1:3:6 concrete, 8 in. thick, as are also the floors of the baggage, express and power buildings. These floors rest directly on a cinder fill.

The mezzanine floor and storage space was designed and

Interior View of Main Waiting Room, Norfolk Union Station.

a 1:2½:5 mixture. This mixture was also used in making the belt and base courses of the baggage, express and power buildings and for the steps in the concourse. Foundation walls have a felt and tar waterproofing course on the exterior of the wall. This waterproofing was three ply, using a felt of minimum weight of 1½ lbs. per sq. yd., and straight run coal tar pitch. The surface of the wall was prepared for the waterproofing by finishing with a smoothly troweled surface coat of 1:2 cement. A heavy coat of hot coal tar pitch was mopped on this surface and a layer of felt placed while the pitch was still hot. The second coat of hot pitch was applied, layer of felt placed, etc., the third thickness completing the waterproofing.

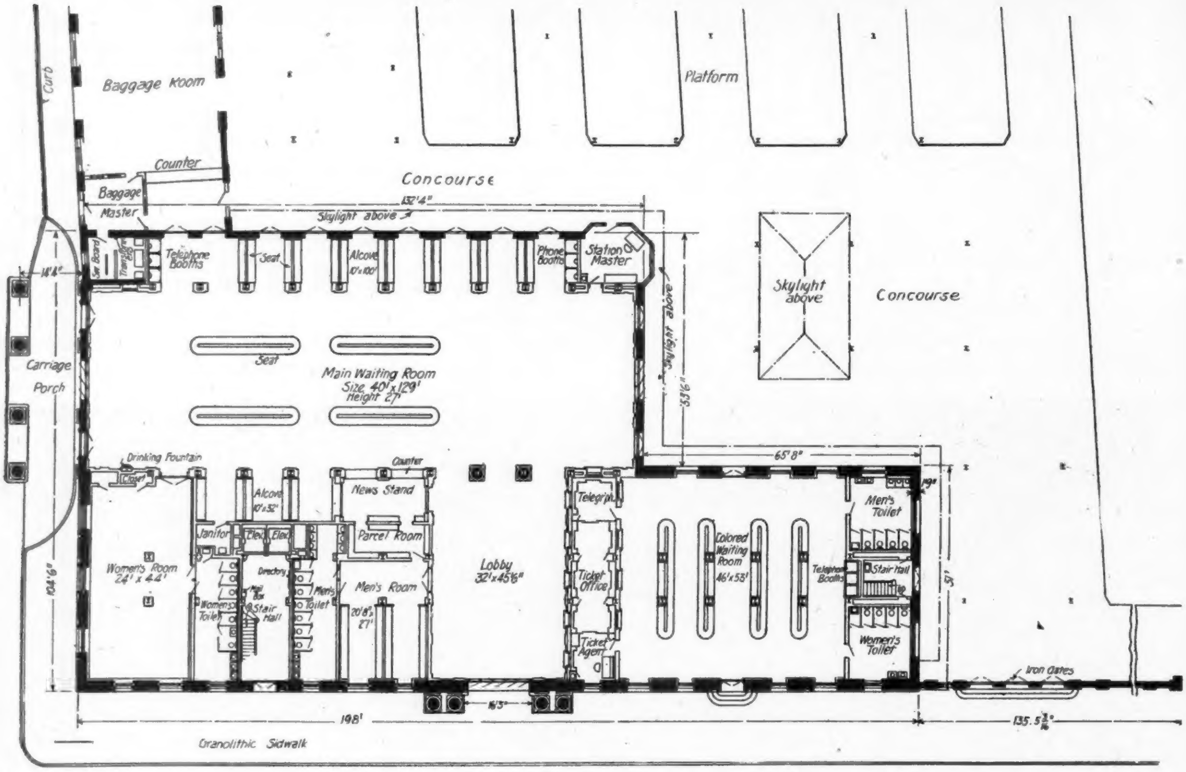
Samples of all cement used were tested by the standard tests specified by the American Society for Testing Materials. The use of gravel or broken stone and sand was optional with the contractor. The requirements for gravel for concrete were very rigid, however. It had to be examined and approved before being delivered on the work. The sand

tested for a load of 450 lbs. per sq. ft. Office floors were designed for a load of 300 lbs. per sq. ft.

The interior walls of the building are of porous clay brick, while the exterior walls are of dense, hard-burned brick lined with hollow terra cotta blocks.

The roof of the concourse is a reinforced slab of a 1:2:4 mixture. Cinder concrete was used for roof filling under slabs. The reinforcing consists of round, open hearth, medium steel bars, with an ultimate strength of from 60,000 to 70,000 lbs. The elastic limit was required to be not less than are half the ultimate. Steel fabric was used at the option of the contractor wherever adaptable. Roof slabs were given a ½-in. finish coat of 1:2 mortar.

All other roofs are of composition roofing, with copper flashings. Galvanized iron skylights, with plain wire glass, are located over the elevator shaft, stair well and in the pent house. The composition roofing used was five ply, placed in a manner similar to that in waterproofing the foundation wall. The first layer of pitch was about 1/16 inch



Station Floor Plan, Norfolk Union Station.

thick. Eave gravel strips, rain water leader bases and sleeves, and roof flashings were placed with a minimum lap of 4 ins. The finish layer was ⅛ inch thick and was covered with gravel while still hot.

The chimney for the power house is 100 ft. high above the fire grade. It is constructed of radial brick with an inside. diameter of 4 ft. 6 ins., lined with fire brick to a height of 20 ft.

The stories above the mezzanine floor are all divided into offices. Each office has a center ceiling lighting fixture with cluster of lights, and also 4 plug-ins for drop lights. Corridors have clusters of lights of same design as office ceiling light. The main waiting room is lighted by ceiling bulbs, each mounted singly in ornamental sockets.

The main and mezzanine floors are heated by the Plenum hot blast system. Offices are heated by a 2-pipe gravity return steam system. A 150 H. P. boiler feeds the steam heating system.

Main Entrance Lobby.

Main Entrance.

Norfolk Union Station.

A complete piping system was installed to heat passenger cars. Steam leaves the boiler at 65 lbs. pressure, and can be taken from outlets at the head of each of the station tracks. At these outlets, connections are made with hose, to the car heating system. The pipe line runs overhead through the baggage and express rooms, and along the concourse ceiling with an overhead return circulation line back to the boiler room. The short supply mains lead off from this main pipe line, to the tracks. The main feeder pipe is 4 ins. in diameter at boiler room. The return pipe has a diameter of 1½ ins. All piping is canvassed and painted.

The water table coarse, bases of columns and door sills are of granite from the Mt. Airy, N. C., quarry. The exterior trim along Main street and Archer's Lane is of Buff-Bedford limestone. A feature of the construction of the building and brick wall enclosing the site is the use of cast cement. The mixture used contained only sand and cement. Ornamental plaster was used in entire ceiling, for cornices, pilasters, column caps, for wall panels and window enrichments. A hard white finish, gauged with lime putty, was applied.

In the main waiting room are two electrically operated clocks with illuminated dials; one has a single, the other a double face.

All exterior masonry, window trim, rudiments, balustrades, sills, belt courses, coping, etc., are of terra cotta.

The building was designed by Reed and Stern, architects, under the supervision of Charles S. Churchill, chief engineer of the Norfolk & Western Ry. The structure was erected by J. Henry Miller, Inc

SANTA FE ROUNDHOUSE AT RIVERBANK, CAL.

The Atchison, Topeka & Santa Fe has recently constructed at Riverbank, Cal., a 90-ft. 15-stall roundhouse which presents several interesting features. It is built entirely of reinforced concrete, conforming in this respect to the present tendency among railroads to make all new structures of a permanent character, thoroughly fireproof.

Although this roundhouse is of the usual type and built of the usual materials, the actual methods of construction are unique. Instead of pouring the concrete in place upon an expensive system of forms, it is cast on the ground in a number of moulds. The structural parts are all cast in this way, and are known as units, the building being constructed along "Unit-Bilt" or "moulded in advance" methods as patented by the Unit Construction Co.

In this work the concrete was poured in wooden moulds arranged in a casting yard adjoining the building site. The reinforcing steel was locked in place in these moulds, which were carefully inspected before concrete was placed. After concrete had set, the members or "Units" were lifted from the moulds by a crane and set in the building much as if they had been structural steel.

The foundation of the building was arranged with slots to hold the columns which were grouted in place after setting. Wall columns were slotted to receive wall slabs and after girders were in place the joint was boxed and a rich concrete grout poured around the steel bars projecting from ends of girders, making a very strong joint. Roof slabs were then placed on girders and all remaining joints grouted. Thus the completed building is practically a monolith; with the added advantage

Interior of Santa Fe Roundhouse at Riverbank.

Casting Yard, Riverbank Roundhouse.

Casting Yard and Roundhouse Site.

that the method of construction insures accuracy of design, quality of workmanship and strength seldom obtained by ordinary reinforced concrete methods.

The windows in the rear wall are about 15 ft. wide, and extend from a point about 3 ft. above the floor to the bottom of the eave strut. There are heavy pilasters at the sides of the windows while the panel below the window is made of very light construction so that an engine pushing through the wall would not in any way damage the structural part of the building, and would cause only slight inconvenience and expense in replacing the window and panel beneath. At the end of the house, provision is made for further extension by making the end wall slabs so that they may be easily removed without damage and by providing special roof connections.

Aside from the construction features, the roundhouse is of the ordinary standard type and presents no unusual features. However, the clean, light and airy appearance of the building is noticeable in the illustrations. This method of putting up buildings while new as applied to roundhouses, has been in general use for several years in various parts of the country in connection with the construction of factories, warehouses, grain elevators.

An incident during this construction gave an excellent example of the advantages offered by "Unit-Bilt" methods. By mistake, the contractor received a quantity of sand containing considerable mica which weakened the concrete. The first roof slab containing this sand, broke as it was being lifted from the mould and all units containing that kind of sand were at once destroyed. Had the building been constructed by ordinary methods the defect would not have been discovered until removal of centering when the building would have collapsed.

This roundhouse was erected by the Van Sant-Houghton Co. of San Francisco, Pacific Coast representatives of the Unit Construction Co. of St. Louis, who control patents covering this method of construction.

MELTING SNOW AND ICE FROM SWITCHES, ETC.

The Turner Tubular Gasoline Torch, recently placed on the market, works a great improvement over the old methods of removing ice and snow from frogs, switches, interlocking connections, etc.

The tool mentioned is a large gasoline blow torch operating on the same principle as the ordinary small gasoline blow torch with which everyone is familiar, but has the heat efficiency of six ordinary torches.

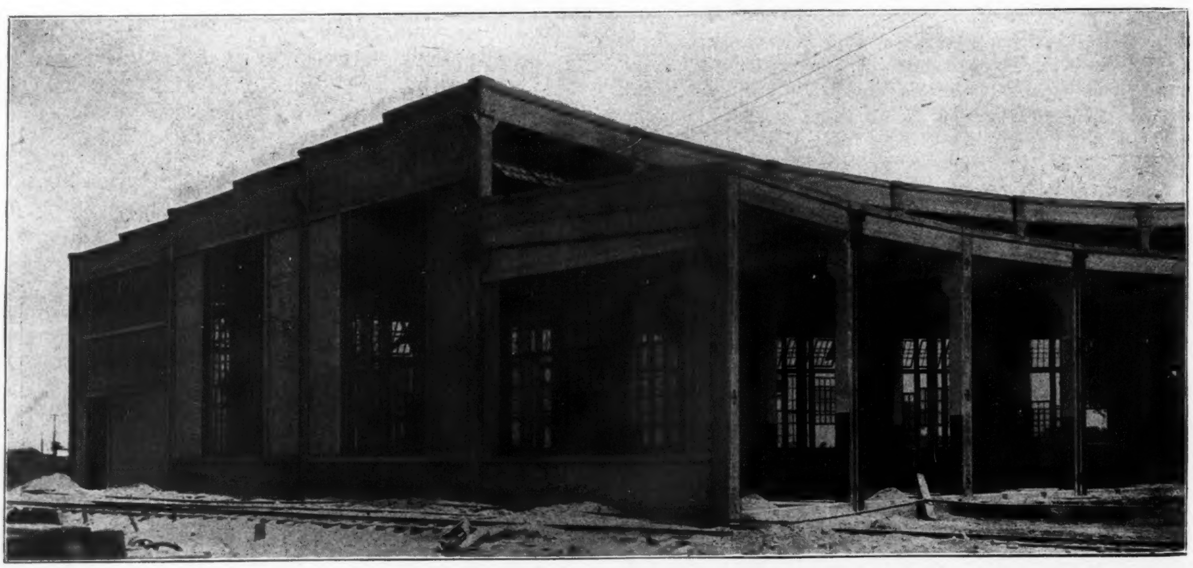
The Turner Tubular Torch, by means of the great heat generated, almost instantly removes snow and ice from switch points, etc. It is handled and operated by one man, and from results shown in actual use, will do the work of several men by the old methods.

A large number of railroads are finding this tool of great value in keeping their switches, interlocking plants, etc., open during cold weather. It weighs about 8 pounds, is 2 inches in diameter, and is 5 feet 9 inches long. The tube, which is the tank, has a capacity of 3 quarts of gasoline, and the torch consumes one quart per hour.

The torch is fitted at one end with a powerful burner and a gasoline valve and pressure pump at the opposite end. The size of the flame at the burner is 2 inches in diameter and is 12 inches long.

The Turner Tubular Torch is being sold by the Track Necessities Company, 36 West Van Buren St., Chicago.

The Georgia Interstate has been incorporated in Georgia to build a line in Madison county via Danielsville. The line may be extended southeast to Augusta. The incorporators include L. B. Greene, T. A. Grimes, J. E. Gordon and J. E. Baker, Danielsville, Ga.



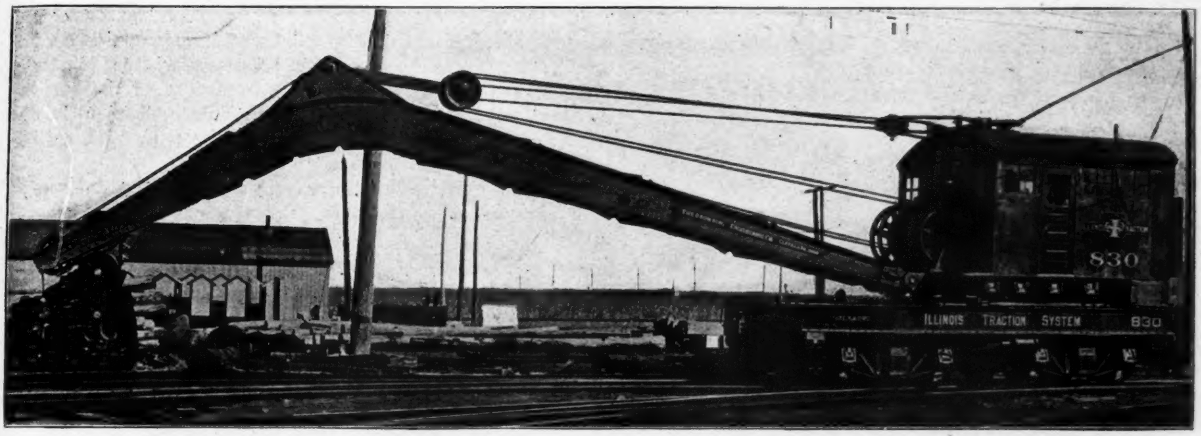
Showing End and Portion of "Unit Bilt" Roundhouse at Riverbank, Cal.

ECONOMICAL RAILWAY CRANE.

The advantages and economies obtained by the use of electric motors as compared with steam engines for operating railway cranes are daily becoming better known. Many orders for electric cranes have resulted, especially for the manufacturers, that have from the first used the most reliable of material and parts.

An electric crane is always ready for duty, an essential of any serviceable crane; there is no time wasted in getting up steam, which is often a series handicap for steam cranes. Another advantage of the electric crane is that power is consumed only when actually being used.

The illustration shows a typical high grade electric crane owned and used by the Illinois Traction Co., and used for wrecking purposes on its Danville and Urbana division. This crane, which was furnished by the Browning Engineering Co., is equipped with a 30-foot goose-neck boom, with a main and an auxiliary hoist. The main hoist has a radius of 25 feet, and the auxiliary hoist a radius of 30 feet. The maximum lifting capacity of the main hoist is 30 tons at 12 feet radius, and 11½ tons at 25 feet radius.



Economical Railway Crane.

The hook speed of the auxiliary hoist is 200 feet per minute while that of the main hoist is 50 feet. The working weight of this crane is 65 tons. Its height is 13½ feet; width, 9 ft. 10 in., and length 24 feet. The distance between truck centers measures 15 ft. 2 in. The wheels are 33 inches in diameter and are of the M. C. B. rolled steel type.

The motors are Westinghouse No. 303 railway type. Operating on direct current, the motors are equipped with commutating poles, so that there are no commutation troubles. The control is also Westinghouse, and designed so that the crane is handled by one man. Power is taken from wires overhead and led to the controllers through a collector ring on the rotating base, and a shoe on the stationary base. All wiring is enclosed in metal and fibre conduit so as to be protected from moisture and mechanical injury. The crane is self-propelling at the rate of 600 feet per minute.

The Oregon-Washington R. R. & Navigation Company will install automatic block signals on 110 miles during the coming year.

The Pennsylvania, it is said, will soon begin installation of an automatic block signal system costing about $800,000 between Harrisburg & Altoona.

The Chicago, St. Paul, Minneapolis & Omaha will install automatic block signals on 65 miles of double track road during 1913. At present automatic block signals are on 19 miles of double track.

The New York, Philadelphia & Norfolk will introduce the manual block system on 17 miles of its line during 1913.

The Alabama Great Southern during the coming year will put all its lines under the block system. At present 112 miles of the line is worked by automatic block signals and 98 miles by non-automatic. The work will include seven miles of automatic block signals, on double track and 73 miles of manual blocking on single track.

The Chicago, Milwaukee & St. Paul it is said, has authorzied the installation of an improved signal block system on its line between Mobridge, S. D., and Milwaukee, Wis., a distance of about 700 miles.

The Chicago, Indianapolis & Louisville is installing automatic block signals on 135 miles of its line. A mechanical interlocking plant of 15 levers will be put up at Haskells, Ind., the crossing with the Grand Trunk.

The Frederick R. R. is said to be reconstructing its yards at Myersville, Md.

The Great Northern has awarded contracts to the American Bridge Co. for 4,784 tons of bridge material to be used in bridges over the Missouri river and Yellowstone river.

The Georgia & Northern, it is said, has awarded a contract to J. W. Dukes, Bainbridge, Ga., for the erection of a freight depot.

The Grand Trunk Pacific is said to be contemplating erecting a large hotel near Vancouver, B. C., at an estimated cost of $250,000.

The Foster-Creighton-Gould Co., which has the contract for the bridge across the Cumberland river, about 4 miles above Nashville, Tenn., for the Louisville & Nashville, expects to complete the substructure next month. The bridge will be 3,000 ft. long and 130 ft. high. The superstructure is composed of a 300 ft. channel span, three 200 ft. through spans, three 125 ft. deck spans and a viaduct approach at each end composed of 30 ft. towers and 60, 70 and 80 ft. spans.

The Northern Pacific, it is reported, has ordered 4,215 tons of bridge material from the Fort Pitt Bridge Wks., and 1,600 tons from the American Bridge Co. It has also awarded the contract for reinforced concrete piers for the steel bridge over Lake Washington canal in Seattle, Wash., to the International Concrete Co., of Seattle, at a contract price of $60,000.

The Oakland, Antioch & Eastern is said to have been granted permission to build a bridge across Suisun Bay at Chipps Island, Cal., and to have engaged architects to prepare plans for same. The approximate cost of the structure is $1,500,000.

Personals

OPERATING DEPARTMENT.

F. D. Batchellor has been appointed assistant to general superintendent of the Baltimore & Ohio Southwestern R. R. office at Cincinnati, O.

J. D. Tyter, formerly assistant superintendent, has been appointed superintendent of the Boston & Maine R. R. at Boston, Mass.

W. D. Cook has been appointed superintendent of the Brinson Ry. at Springfield, Ga., succeeding W. A. Walker.

W. C. Fearce has been appointed superintendent of the Chesapeake & Ohio Ry. at Clifton Forge, Va.

W. P. Hudson has been appointed general superintendent of the Chesapeake & Ohio Ry. of Indiana, office at Peru, Ind.

E. B. McClure has been appointed superintendent of the Chicago & Northwestern Ry. at Sioux City, Ia., succeeding A. W. Towsley.

B. R. Pollack, General Manager, N. Y. N. H. & H. R. R.

W. H. Molchoir has been appointed superintendent of the Chicago, Milwaukee & St. Paul Ry. Puget Sound lines, at Three Forks, Mont., succeeding J. E. Hood.

P. H. Conroy, formerly assistant superintendent of the Colorado & Southern Ry. at Cheyenne, Wyo., has been appointed superintendent at Denver, Colo. W. L. Smith, formerly trainmaster, has been appointed assistant superintendent at Cheyenne, Wyo., succeeding P. H. Conroy.

F. E. Clarity has been appointed superintendent of transportation of the Denver & Rio Grande R. R. office at Denver, Colo. R. T. McGraw, formerly assistant superintendent, has been appointed superintendent at Alamosa, Colo., succeeding I. H. Luke, who has been transferred to Salida, Col., succeeding O. J. Ogg.

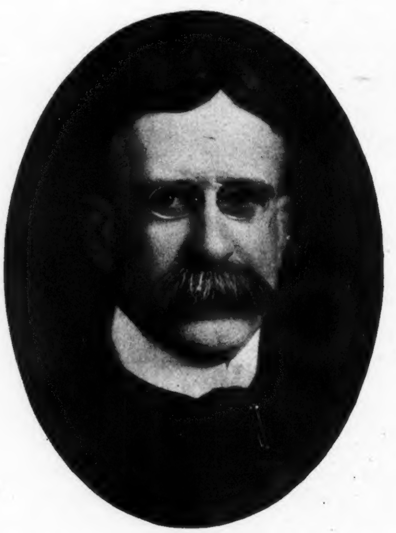
Albert J. Stone, formerly general superintendent, has been appointed general manager of the Erie R. R. lines east of Buffalo, with office at New York. C. A. Allen, formerly assistant general superintendent, has been appointed assistant general manager, lines east, office at New York. Henry O. Dunkle, formerly general superintendent, has been appointed general manager of lines west of Buffalo and Salamanca, office at Cleveland, O. E. W. Batchelder, formerly assistant superintendent, has been appointed assistant general manager, lines west, office at Cleveland, O. The office of general superintendent has been abolished. John B. Dickson has been appointed superintendent, with office at New York. F. G. Robbins has been appointed superintendent of the Buffalo division; office at Buffalo, N. Y.

W. F. Schaff has been appointed superintendent of the Lake Shore & Michigan Southern Ry. at Detroit, Mich, succeeding T. W. Niles.

H. Shearer, formerly superintendent of the Michigan Central R. R., has been appointed assistant general manager, with office at Detroit. M. T. Wright has been appointed superintendent at Jackson, Mich., succeeding W. H. O'Keefe, who has been appointed terminal superintendent at Detroit.

D. J. Hackett, who was appointed superintendent of the Michigan Central R. R. January 1, St. Thomas, Ont., was born in 1868, and entered the service of the Michigan Central as messenger boy in 1884. He was successively timekeeper, chainman, rodman, freight clerk, operator, car checker, switchman, assistant yardmaster and yardmaster at Detroit. He was transferred to Toledo as general yardmaster and later became assistant trainmaster, Toledo division nd terminals. He was appointed trainmaster of the Middle division, and in 1910 assistant superintendent of the same division, and was transferred to the Toledo division July 1, 1912, in the same capacity, which position he held until his present appointment.

Mr. Wm. O'Herin has been appointed assistant to general manager of the Missouri, Kansas & Texas Ry., office at Dallas, Tex.



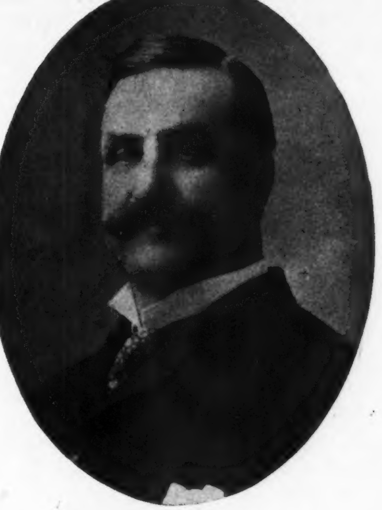
A. M. Schoyer, General Manager, Vandalia R. R.

W. P. Danforth, superintendent of the Missouri, Kansas & Texas Ry., of Texas, has been transferred from Greenville to Trinity, Tex., succeeding A. N. Williams, assigned to other duties.

H. W. Sheridan has been appointed general superintendent of Morgan's Louisiana & Texas R. R., office at New Orleans, La.

D. B. Carson has been appointed assistant general manager of the Nashville, Chattanooga & St. Louis Ry., office at Nashville, Tenn.

Benjamin R. Pollock, who was appointed general manager of the New York, New Haven & Hartford R. R., December 8th, with office at New Haven, Conn., was born January 2, 1865, at Lansford, Pa. He was educated in the public schools, and began work with the Lehigh Coal & Navigation Co. in 1879 as an operator, remaining until 1881, when he went to the New York & New England R. R., which later became the New England R. R., and was absorbed in 1898 by the New York, New Haven & Hartford R. R.



V. A. Riton, General Superintendent, Norfolk & Western Ry.

From 1881 to 1898 he was consecutively telegraph operator, train dispatcher, chief dispatcher, trainmaster and assistant superintendent. In 1898 he was appointed assistant superintendent of the Highland division of the New York, New Haven & Hartford R. R., remaining in that position until January, 1904, when he became superintendent of the Air Line Northampton division of the same road at New Haven. The following December he was made superintendent of the Highland division and later was appointed superintendent of the Midland division. Since October, 1909, he has been general superintendent of the same road, with office at New Haven.

J. D. Gallary, who was appointed superintendent of the New York, New Haven & Hartford R. R. December 8, Providence, R. I., entered railway work as messenger boy on the Erie R. R. in 1886, and in 1887 went with the Pennsylvania as telephone boy. Later in that year he became a telegraph operator and in 1889 went with the Buffalo, Rochester & Pittsburgh Ry. in the same capacity. In 1890 he accepted a position with the Louisville & Nashville R. R. as telegraph operator and clerk, and in 1892 went with the Chicago, Milwaukee & St. Paul Ry. as telegraph operator. He accepted a position with the Chicago & Northwestern Ry. later in 1892, and in 1894 went with the Lehigh Valley R. R., where he was successively telegraph operator, towerman, clerk, yardmaster and assistant general yardmaster. In 1902 he went with the Lake Shore & Michigan Southern Ry. as yardmaster, and in 1903 accepted the position of general yardmaster with the Chicago, Rock Island & Pacific Ry. He was appointed trainmaster of the New York, New Haven & Hartford R. R. in 1907, and later was promoted to assistant superintendent, which position he held until his present promotion.

Arthur B. Shafer, who was appointed acting superintendent of the New York, Susquehanna & Western R. R. December 16, entered the service of that company June 2, 1894, as agent and operator. He was transferred as operator to the superintendent's office at Jersey City, October 10, 1894. March 26, 1895, he was appointed train dispatcher, and was promoted to chief train dispatcher Sept. 1, 1904. He was appointed trainmaster, which position he held until his present appointment.

A. C. Needles, who was appointed general manager of the Norfolk & Western Ry. December 1, Roanoke, Va., was born in 1867 at Baltimore. He attended Swarthmore College, and first entered railway work in 1882 as rodman on the Washington, Ohio & Southern R. R. In 1883 he became rodman on the Norfolk & Western R. R., and later in the same year was yard clerk and brakeman. He was appointed yardmaster in 1884, holding this position at Pulaski, Va., and Bluefield, W. Va., until 1890. In the latter year he was appointed assistant trainmaster. December 25, 1898, he was appointed trainmaster of the Radford division, and May 22, 1901, he was appointed assistant superintendent of the Pocahontas division; he was promoted to superintendent of the Shenandoah division June 22, 1901. October 6, 1901, he was transferred to the Norfolk division, and December, 1902, was transferred to the Pocahontas division. In February, 1904, he was appointed general superintendent, which position he held until his present appointment.

V. A. Riton, who was appointed general superintendent of the Norfolk & Western Ry. December 1, Roanoke, Va., was born at Johnstown, N. Y. He graduated from Johnstown Academy and entered railway service in 1872. From that time till 1875 he held consecutively the positions of rodman, level man and assistant engineer of construction on the New York & Canada Ry. and the Delaware & Hudson Canal Co. From 1877 to 1889 he was assistant engineer on the Plattsburg & Dannemora Ry., and in 1879 accepted a similar position with the Chicago & Northwestern Ry. He entered the service of the Chicago, Milwaukee & St. Paul Ry. later in the same year, as assistant engineer, and was appointed roadmaster of the Mineral Point division of that road in 1882. In 1889 he was made roadmaster of the Chicago division, and was appointed superintendent of the Cascade division of the Great Northern Ry. in 1895. He entered the service of the Norfolk & Western Ry. in 1889 as superintendent of the Sciota division, and was transferred to the Pocahontas division in 1901. In 1903 he was employed in the president's office, and in 1904 was made superintendent of the Shenandoah division. He was appointed superintendent of the Norfolk division at Crewe, W. Va., in 1905, which position he held until his appointment as general superintendent.

J. D. Hester, who was appointed superintendent of the Shenandoah division of the Norfolk & Western Ry. December 1, Roanoke, Va., was born September 26, 1866, at Marion, Va. He entered the service of the Norfolk & Western Ry. as freight delivery clerk at Marion, in 1855. He studied telegraphy and was appointed assistant agent and operator in 1886. In 1889 he entered the train service as brakeman and was promoted to freight conductor in 1890. He was appointed trainmaster in 1899, and was promoted to trainmaster, Shenandoah division, in 1901, and was transferred to the Radford division, in the same capacity, 1905, which position he has held until his present appointment.

H. C. Weller, who was appointed superintendent of the Norfolk & Western Ry., Bluefield, W. Va., December 1, was born April 28, 1871, at Chillicothe, O., and was educated in the public schools. He entered railway service in 1886 as a telegrapher on the Norfolk & Western Ry. and was later promoted to the positions of agent, train dispatcher and yardmaster. He was appointed trainmaster at Bluefield, which position he held until his recent appointment.

J. L. McCullough has been appointed division superintendent of the new Puget Sound division of the Northern Pacific Ry., with offices at Tacoma and Seattle.

J. L. Hayes, who was appointed superintendent of the Saginaw division of the Pere Marquette R. R., Saginaw, Mich., entered railway service as a fireman on the Grand Trunk Ry. in 1881. He went with the Pere Marquette as brakeman in 1882, and was promoted to freight conductor in 1885 and passenger conductor in 1890. He accepted the position of general yardmaster with the Pennsylvania R. R. in 1893, and became gen-

eral yardmaster on the Pere Marquette at Toledo in 1898. He was appointed trainmaster of the Toledo division in 1903, which position be held until his present appointment.

W. S. Bake, who has been appointed trainmaster of the Pere Marquette R. R., Traverse City, Mich., entered the service of the Pere Marquette in December, 1911, as assistant engineer in charge of the drafting room for J. F. Deimling, chief engineer, serving in this capacity and in special engineering work until October 1, 1912, when he was appointed division engineer of the Petosky division. Preceding his service with the Pere Marquette, he held the position of assistant engineer on the Pennsylvania Lines West about seven years. He held a similar position for one year on the Southern Ry., and was in governmental service for one year at Grand Rapids, Mich. Mr. Bake assumes the duties of trainmaster and retains his duties as division engineer.

Chas. H. Ewing has been appointed superintendent of the Philadelphia & Reading Ry. at Reading, Pa. W. F. Eckert has also been appointed superintendent at Reading, succeeding F. M. Falck.

T. W. Parsons, formerly assistant superintendent, has been appointed superintendent of the Seaboard Air Line R. R. at

W. S. Bake, Trainmaster, Pere Marquette R. R.

Tampa, Fla. H. W. Purvis has been appointed superintendent at Jacksonview, Fla.

Mr. A. M. Schoyer was appointed general manager of the Vandalia R. R., with office at St. Louis, Mo., effective January 1, 1913, succeeding Mr. B. McKeen, who on the same date became general manager of the Pennsylvania Lines West of Pittsburgh. Mr. Schoyer was born November 1, 1859, at Allegheny City, Pa., first entered railway service in 1872, serving as messenger, telegraph operator, chief operator, train dispatcher, chief train dispatcher, superintendent telegraph, division superintendent, and general superintendent, all with the Pennsylvania Lines West of Pittsburgh. It was in 1892 that he was appointed superintendent of Telegraph. He served as superintendent of the Eastern division from November 1, 1899, to December 31, 1901, and as general superintendent since January 1, 1902. He was superintendent of telegraph of the Vandalia R. R. as well as of the Pennsylvania Lines West of Pittsburgh 1893 to 1899.

A. R. Merrick has been appointed general superintendent of the Western Maryland Ry., with office at Baltimore, Md.

H. W. McMaster has been appointed general manager of the Wheeling & Lake Erie R. R., with office at Cleveland, O.

J. G. Code, formerly general superintendent of the Wheeling & Lake Erie R. R., has been appointed general manager of the Wabash Pittsburgh Terminal Ry. at Pittsburgh, succeeding H. W. McMaster.

ENGINEERING DEPARTMENT.

G. C. Millett, formerly engineer Grand division, has been appointed assistant chief engineer of the Atchison, Topeka & Santa Fe (Coast Lines), office at Los Angeles, Cal. R. B. Ball, formerly division engineer, has been promoted to engineer Grand division at Los Angeles, succeeding G. C. Millett. R. S. Haynes has been appointed division engineer at San Francisco, succeeding R. B. Ball.

H. A. Cassil has been appointed division engineer of the Baltimore & Ohio Southwestern R. R. at Seymour, Ind., succeeding F. D. Batchellor, promoted.

R. J. Middleton, formerly valuation engineer, has been appointed engineer of track elevation of the Chicago, Milwaukee & St. Paul Ry., office at Chicago.

H. G. Snyder has been appointed division engineer of the Cincinnati, Hamilton & Dayton Ry., at Dayton, O., succeeding H. F. Passel, promoted.

Geo. H. Jennings, formerly superintendent of bridges and buildings of the Elgin, Joliet & Eastern Ry., has been appointed assistant chief engineer in charge of maintenance of bridges, structures, and track, with office at Joliet, Ill. Christ Thompson, formerly division engineer and division superintendent of bridges and buildings, Gary division, has been appointed superintendent of bridges and buildings of the Joliet division, office at Joliet, Ill., succeeding T. H. Jennings, promoted. F. H. Masters has been appointed division engineer and superintendent of bridges and buildings of the Gary division, office at Gary, Ind., succeeding Christ Thompson, promoted.

Ralph Budd, formerly chief engineer of the Spokane, Portland & Seattle Ry., has been appointed assistant to the president of the Great Northern Ry., office at St. Paul, Minn.

A. S. Going, who was appointed engineer of construction of the Grand Trunk Ry. December 1, 1912, was born at Portland, Ore., in 1860, and entered railway service in 1880 as instrument man on the Oregon Railway & Navigation Co. In 1881 he entered the service of the Northern Pacific Ry., as assistant engineer, and accepted a similar position with the Oregon Pacific Ry. in 1884. He was appointed resident engineer on the Seattle, Lake Shore & Eastern Ry. in 1887, and was resident engineer on the Northern Pacific Ry. in 1888-9. From 1890 to 1902 he engaged in private practice in Washington and British Columbia. In 1903 he again entered railway service as division engineer of the Great Northern Ry., and in 1904 went with the Grand Trunk Pacific Ry. as exploration engineer for British Columbia. He was appointed division engineer of the Minneapolis & St. Louis Ry. in 1905, and went with the Grand Trunk Ry. in 1907 as locating engineer in charge of surveys, which position he held until his appointment December 1, 1912.

J. G. Seyfried has been appointed structural engineer of the Grand Trunk, office at Montreal, Que. H. B. Stuart has also been appointed structural engineer, office in Montreal.

E. C. Haynie has been appointed assistant engineer on the Louisville division of the Louisville & Nashville R. R., office at Louisville, Ky.

O. L. Vandament, who was appointed assistant engineer of the Louisville & Nashville R. R. at Louisville, Ky., December 16, was formerly in the chief engineer's office. Previous to then he was track engineer, American Rolling Mill Co., and for a considerable period assistant on engineering corps, Pennsylvania Lines West.

H. E. Hale, formerly engineer of maintenance, has been appointed engineer maintenance of way of the Missouri Pacific Ry., office at Little Rock, Ark. H. R. Carpenter,

formerly assistant engineer, has been appointed engineer maintenance of way, office at St. Louis, Mo. H. R. DeWitt, assistant enginer of the Missouri Pacific Ry., has been transferred from Van Buren to Wynne, Ark., succeeding R. H. Hallsted, assistant engineer, transferred to Little Rock, Ark.

A. L. Grandy, formerly division engineer, has been appointed chief engineer of the Pere Marquette R. R., office at Detroit, Mich. A. B. Ziegwied has been appointed division engineer at Saginaw, succeeding A. L. Grandy, promoted. A. R. Dewees has been appointed division engineer at Saginaw, Mich.

W. D. Faucette has been appointed chief engineer of the Seaboard Air Line R. R. at Portsmouth, Va., succeeding W. L. Seddon, promoted. J. L. Kirby has been appointed division engineer at Atlanta, Ga., succeeding L. L. Beall, who recently accepted a position with another company. W .J. Gooding, Jr., division engineer, has been transferred from Savannah, Ga., to Jacksonville, Fla. B. Land, Jr., division engineer, has been transferred from Jacksonville to Tampa, Fla. R. B. Gandy has been appointed division engineer at Savannah, Ga. B. F. Boynton has been appointed master carpenter at Jacksonville, Fla.

O. T. Waring, Engineer of Roadway, Atlantic Coast Line R. R.

S. Baldwin has been appointed resident engineer of the Trinity & Brazos Valley Ry. at Teague, Tex., succeeding F. A. Pollak.

W. L. Rohbock, who was appointed chief engineer of the Wheeling & Lake Erie R. R. December 1, Cleveland, O., was born in Pittsburgh, June 7, 1873. He was educated in the Pittsburgh public schools and spent a number of years with various manufacturing concerns in Pittsburgh, including the Westinghouse Electric & Manufacturing Co., and the Pittsburgh Railways Co. He entered the service of the Wheeling & Lake Erie R. R. in June, 1906, as assistant engineer, was appointed assistant chief engineer in 1909, acting chief engineer July 1, 1912, and chief engineer December 1, 1912.

Maintenance of Way.

D. O'Connell has been appointed roadmaster of the Atchison, Topeka & Santa Fe Ry. at Slaton, Tex. E. A. Warren was appointed roadmaster at Plainview, Tex. on December 1, 1912. He was previously appointed acting roadmaster August 20, 1912. J. H. Tate, roadmaster, has been transferred from Vaughan to Clovis, N. M.

O. T. Waring has been appointed engineer of roadway of the Atlantic Coast Line R. R. at Savannah, Ga. Mr. Waring graduated from the University of Pennsylvania in 1902, civil engineering course. In July of that year he began railway work in the engineering department of the Baltimore & Ohio R. R. He was promoted to assistant division engineer in July, 1903. He accepted a position with the Atlantic Coast Line R. R., as assistant engineer, in August, 1905, leaving that company in November, 1906, to accept a position as assistant engineer with the Charleston & Western Carolina. He was promoted to assistant superintendent in November, 1907, and returned to the Atlantic Coast Line R. R. as roadmaster the following year. From September, 1909, to October, 1910, he held the position of acting engineer of roadway, and was then appointed assistant engineer. He was appointed superintendent of the Winston-Salem district, which position he held till his present promotion.

L. S. Allen, formerly roadmaster of the Ann Harbor R. R., has been appointed engineer maintenance of way, office at Ann Harbor, Mich.

W. L. Rohbock, Chief Engineer, Wheeling & Lake Erie R. R.

C. H. Hile has been appointed chief of the Bureau of Maintenance of the Boston Elevated Ry., office at Boston, Mass.

F. M. Corbett has been appointed supervisor of the Chicago & Alton Ry. at Springfield, Mo.

Thomas Flynn has been appointed roadmaster of the Chicago, Milwaukee & Puget Sound Ry., at East Portal, Mont., succeeding E. L. Whiting.

J. F. Weatherman has been appointed roadmaster of the Chicago, Rock Island & Pacific Ry at Haileyville, Okla., succeeding F. E. Watson.

D. D. Duffy, roadmaster of the Delaware, Lackawanna & Western R. R., has been transferred from Kingston to Scranton, Pa.

T. Kennedy, roadmaster on the Denver & Rio Grande R. R., has been transferred from Salt Lake City to Helper, Utah. J. Spillane, formerly roadmaster at Thistle, succeeds Mr. Kennedy at Salt Lake City.

G. B. Bregan has been appointed supervisor of track of the Erie R. R. at Elmira, N. Y., succeeding W. J. Alynn. Wm. Gromer has been appointed supervisor of track at Meadville, Pa., succeeding J. Pierson. W. Kruchbaum has been appointed supervisor of track at Huntington, Ind., succeeding A. Burgett. C. M. Lewis, supervisor of track,

has been transferred from Buffalo, N. Y., to Jersey City, N. J. J. H. Lynch, supervisor of track, has been transferred from Montclair, N. J., to Buffalo, N. Y.

J. B. Hardy, roadmaster on the Galveston, Harrisburg & San Antonio Ry., has been transferred from Rosenberg to Wharton, Tex. W. S. Higgins, roadmaster, has been transferred from Wharton to Victoria, Tex. V. C. Wall has been appointed roadmaster at Rosenberg, Tex.

T. J. Cherpeski has been appointed assistant roadmaster of the Great Northern Ry. at Garretson, S. D. A. F. Fiala, assistant roadmaster, has been transferred to Willmar, Minn. James Lakaskie has been appointed assistant roadmaster at Minneapolis, Minn.

G. C. McMillan, Jr., has been appointed roadmaster of the Lake Shore & Michigan Southern Ry. at Hillsdale, Mich.

J. F. Burns, formerly roadmaster, has been appointed assistent engineer maintenance of way of the Louisville & Nashville R. R., office at Louisville, Ky. Mr. Burns was born in 1869, graduated from Ohio State University in 1891. He began service in the fall of the same year with the L. & N., being, to date, continuously in the service of that company as assistant engineer and roadmaster. F. M. Cates, formerly assistant engineer, has promoted to roadmaster at Louisville, Ky. He has been employed as assistant engineer on the Louisville division for several years.

Neal Campbell has been appointed roadmaster of the Missouri Pacific Ry. at Van Buren, Ark., succeeding T. H. Gaffney.

J. R. Cralle has been appointed roadmaster of the Norfolk & Western Ry. at South Boston, Va. O. H. Tolly, roadmaster, has been transferred to Crewe, Va.

W. M. Edwards, roadmaster on the Seaboard Air Line Ry., has been transferred from Waldo to Archer, Fla. B. J. Fort, roadmaster, has been transferred from Plant City to Jacksonville, Fla. M. H. Hunter has been appointed roadmaster at Plant City, Ga. W. M. Hartin has been appointed roadmaster at Tampa, Fla., and J. L. King has been appointed roadmaster at Wellington, Ala.

Thomas Bernard, formerly engineer maintenance of way of the Southern Ry. at Greensboro, N. C., has been appointed assistant to chief engineer maintenance of way, office at Greensboro, N. C. W. T. Dobyns has been appointed engineer maintenance of way at Greensboro, succeeding Mr. Bernard. G. P. Asbury has been appointed assistant engineer at Washington, D. C. E. S. Davis has been appointed assistant engineer at Knoxville, Tenn. O. B. Lackey, assistant engineer, has been transferred from Knoxville, Tenn., to Spencer, N. C. J. I. Lee, assistant engineer, has been transferred from Washington, D. C., to Greensboro, N. C. H. M. Payne has been appointed assistant engineer at Birmingham, Ala., and J. F. Ziglar has been appointed assistant engineer at Charlotte, N. C.

J. Gandaro has been appointed roadmaster of the Southern Pacific of Mexico, at Acaponeta, Tepic, Mex.

Signal Officials.

S. R. Thompson has been appointed supervisor of signals of the Chesapeake & Ohio Ry., office at Huntington, W. Va.

R. F. Annear has been appointed signal supervisor of the Chicago, Rock Island & Gulf Ry., office at Ft. Worth, Tex., succeeding R. R. Baker.

F. Bridge has been appointed signal inspector of the Erie R. R. at Susquehanna, Pa., succeeding J. P. Kreiter.

N. S. Lynch, signal supervisor of the Missouri Pacific Ry., has been transferred from McGhee to Wichita, Kan. O. R. Thurston has been appointed signal supervisor at McGehee, Ark., succeeding N. S. Lynch. F. E. Baugh has been appointed signal supervisor at Kansas City, Mo., succeeding W. F. Ward.

RAILWAY CONSTRUCTION.

The Kentucky North & South is having surveys made for a line from a point near South Portsmouth, O., into the Eastern Kentucky coal fields, terminating at Norton, Va., where the road will connect with the Louisville & Nashville and the Norfolk & Western.

The Macomb & Western Illinois, it is reported, is making surveys for an extension from Macomb, Ill., northwest to Stronghurst, 25 miles, and from Littleton on the southern end south to Rushville, 10 miles.

The Montana Eastern has been incorporated in Montana with a capitalization of $10,000,000 and will construct a line from New Rochford, N. D., through Montana as far as Lewistown, a distance of about 565 miles.

The Nevada, Lebanon & Eastern, Nevada, Mo., has been incorporated in Missouri, with a capital of $1,000,000, to build a railroad about 100 miles in length to connect Nevada with Lebanon and pass through Stockton, Bolivar, Polk and Buffalo.

The surveys have been made to build an extension of the North Shore Ry. & Nav. Co. from Richibucto Head, N. B., to Snowshoe Lake.

The Red Creek, it is reported, has been chartered in Virginia to construct a railroad. The incorporators are D. G. Wilson, R. B. Horsburgh, E. W. Bechtel, L. R. Harvey and A. J. Armstrong, all of Hendricks, W. Va.

The Alexandria & Western, which has been surveyed and for which rights of way have been obtained, will be built along the south bank of Bayou Rapides from Alexandria, La., as far as Lamothe and at that point it will branch out to the pine holdings of the Bayou Rapides Lumber Co.

The Chicago, Sioux Falls & Pacific is said to have been incorporated under the laws of South Dakota to construct a railway from Seattle, Wash., to Chicago, Ill. The capital stock is $14,000,000.

The Dominion Atlantic has awarded a contract to Kirk & Cooke, N. S., for constructing an extension from Centreville, N. S., to Weston, N. S., a disance of about 14 miles.

The Fairchild & Northeastern has work under way on a 7-mile section from Strader to Emmet. Peter Nelson & Co., Minneapolis, Minn., have the contract.

The Appalachian Ry. has started surveys on a line from Williamsburg, Ky., to Petros, Tenn., approximately 60 miles.

The Batesville Southwestern is building with its own forces a section of 3 miles, from mile post 14 to Crowder, Miss., of the extension projected some time ago to Charleston.

The Cary North & South is working on the line from Cochran, Ga., to Cary, 10 miles, and is making surveys from Cary to Toomsboro, 29 miles.

The El Paso & Southwestern has completed the extension of its line from Fairbank, Ariz., to Tucson, Ariz., connecting at the latter point with the Southern Pacific Co. The line was opened for local freight traffic on November 20, 1912. Through freight service from Eastern defined territory to the Pacific Coast, in connection with the Southern Pacific lines, will be inaugurated about January 1.

The Georgia Coast & Piedmont is reported to be considering an extension from Reidville to Lyons, a distance of about 25 miles. At the latter point the railway will make a connection with the South Georgia.

The Grand Trunk has purchased land 3 miles from Prescott, Ont., and will establish a division point there. A round house, shops and sidings will be constructed.

The Tidewater Southern, it is reported, has been extended from Bridge, Cal., north to Stockton 25 miles.

The Western Maryland is planning to have construction work started in the spring on its proposed low grade line from Williamsport to a point near Westminster. It is also likely that the company will take up soon the double tracking of its line between Williamsport and Hancock.

CONCRETE DEPARTMENT

Concrete in Bridge Construction.

THE article on "Concrete Bridges and Viaducts" appearing in this issue should be of special interest to all engaged in concrete work and in bridge design and construction. We doubt if a more complete collection of descriptions and illustrations of large and attractive concrete bridges has ever been published, and we must extend our hearty thanks to all those individuals and corporations who so willingly furnished photographs and data for this article.

The indisputable fact emphasized is that concrete is a material without peer for the construction of bridges where esthetic and economic considerations are next to strength in importance. The longer life, low maintenance cost and the artistic possibilities of concrete bridges have led to their adoption by nearly all railroads in all permanent work.

The various methods and means used to break up the monotonous uniformity of color and unsightly form marks, the cause of most of the objections to early concrete bridges, are subjects deserving of considerable study, since much of the advance in artistic and esthetic treatment has been the result of earnest endeavors to eliminate these objections.

Another noticeable fact brought out, is the tendency in the latest arch designs to use and place concrete and steel as economically as possible; in other words, to put it where it will act in the most effective and efficient manner. The knowledge and experience gained from the behavior and condition of various types of structures in service has placed concrete bridge design on a close competitive basis with steel structures.

The extensive track elevation and depression projects carried out in various parts of the United States have necessitated a vast expenditure of money. For the benefit of all concerned, this work should be done in the most economical manner consistent with good design and artistic considerations. That this can be done with concrete in a more suitable manner than with any other material is forcibly demonstrated by the latest designs where concrete is used in its most economical form, viz., in the shape of concrete decks composed of T-beam slabs in multiple. Some steel bridges have been encased in concrete in such a manner as to make the structures very pretty and attractive. This method, although it can be made to produce the desired results from an artistic standpoint, is by no means economical. For this reason we believe that in the future all such structures will be of reinforced concrete except where conditions demand a steel structure.

NATIONAL ASSOCIATION OF CEMENT USERS.

At the ninth annual convention of the National Association of Cement Users, held at Pittsburgh, December 10-14, 1912, several good papers on the use of concrete in railroad work were read. The most noteworthy of these, which we hope to abstract in these columns at a later date, were:

"Reinforced Concrete in Railroad Work," by M. A. Long, architect B. & O. R. R. The paper was confined mainly to waterproofing, surface treatment and floor dusting and related features which concern the architect.

"Some Recent Applications of Concrete in Railroad Work," by Frederick Auryansen, bridge engineer, Long Island R. R. This paper describes bridges and walls built by the Long Island R. R. "Application of Concrete in the Abolition of Grade Crossings," by James W. Phillips, assistant engineer, Department of Public Works, Philadelphia, Pa. A paper on concrete track elevation structures in Philadelphia. "Some Recent Applications of Concrete and Reinforced Concrete in the City of Pittsburgh," by Norman S. Sprague, superintendent, Bureau of Construction, Department of Public Works, Pittsburgh, Pa.

"The Effect of Electric Current on Concrete," by E. P. Rosa, Burton McCollum and O. S. Peters, of the U. S. Bureau of Standards.

CONCRETE COSTS.

The following table of approximate costs of completed concrete structures per cubic yd. of concrete, taken from "Concrete Costs" by Taylor & Thompson, is of value in making approximate estimate of costs of various structures. These costs include cost of excavation, forms, steel, miscellaneous work, superintendence, overhead charges and general expense.

In using this table it should be remembered that it is not possible to make an exact estimate of the cost of a structure, but a very close approximation can be made if the general type of the structure is known, the cost depending very largely upon whether the work is simple or very intricate.

The fact should always be borne in mind, that the use of any data as to costs of structures should be used with the judgment and knowledge furnished by past experience and that serious errors can be made in estimates by coupling inexperience with approximate cost data such as given below.

Approximate Costs of Completed Concrete Structures.

		Cost per cu. yd. Range.		Average.
1.	Mass foundations	$ 4.00 to	$ 9.00	$ 7.00
2.	Bridge piers and abutments	7.00 to	15.00	10.50
3.	Large arches, 125 ft. span and over	12.00 to	28.00	19.00
4.	Arches, 50 to 125 ft. span	7.00 to	18.00	11.50
5.	Small arches, 30 to 50 ft. span	5.00 to	17.00	9.50
6.	Small arches, less than 30 ft. span, culverts, etc	5.00 to	12.00	9.50
7.	Girder bridges	7.00 to	18.00	12.50
8.	Tunnels, tunnel lining, subways, not including excavation	6.00 to	42.00	15.00
9.	Core walls, gravity retaining walls	6.00 to	8.00	7.00
10.	Reinforced retaining walls	12.00 to	15.00	13.50
11.	Tanks, standpipes	4.00 to	20.00	12.00
12.	Building construction, total building	8.00 to	26.00	14.00
13.	Encasing structural steel in concrete	14.00 to	21.00	18.50
14.	Concrete pipe	11.00 to	15.00	12.50
15.	Concrete piles, cost per linear foot	0.51 to	1.60	1.15

CEMENT SHOW.

The Sixth Annual Chicago Cement Show will be held at the Coliseum, January 16-23, 1913.

The cement shows are instructive exhibits of cement products and appliances showing the wonderful progress in the cement field. Coming as they do at a time of the year when the engineer contractor and dealer are somewhat at leisure, a very profitable day can be spent observing the modern methods, materials and economies in the concrete industries, that are exhibited.

Concrete Bridges and Viaducts

Representative American Highway and Railway Bridges and Track Elevation Structures.

A. M. Wolf.

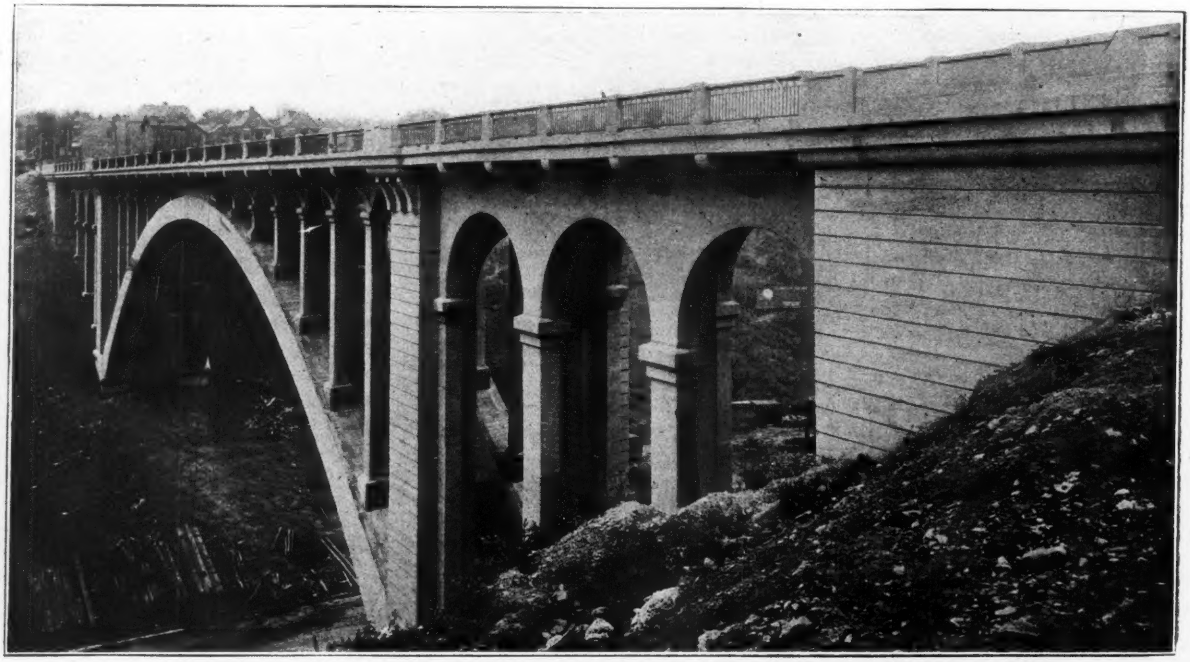
In view of the seeming incredible development of the use of concrete, plain and reinforced, in bridge construction in the last decade, a compilation of large and artistic structures built during that period should prove of more than common interest to engineers, architects, constructors and even to the layman.

The great number and variety of bridges built, necessitates the limitation of this article to representative structures, as regards type, size and general esthetic features. As a result, only the largest and most attractive bridges are illustrated and described.

Highway bridges of large size are described at the outset, since they represent the possibilities of concrete when used in large structures requiring architectural treatment in keeping with their environments. All large highway bridges have been erected in populous districts where something besides a plain structure capable of carrying the imposed loads is demanded. The result is that the United States now boasts of concrete structures, the beauty and grace of which are surpassed by none, even in Europe where nearly all bridges are considered beautiful.

Railway bridges as now built are of smaller spans and have more simple architectural treatment than highway bridges, as is entirely consistent, with loads to be carried, with economic construction, and the environments. However, as this article will show, esthetic considerations are constantly becoming more paramount in the design of railway bridges, and this is sufficient reason to believe that the day is not far distant when ugly railroad bridges will be a thing of the past. That the size of spans for railroad structures now being designed and built is increasing, is witnessed by the 180 ft. ribbed arch spans of the Tunkhannock Creek Viaduct now being built by the D. L. & W. R. R. (described on page 515 of the November issue.) Another interesting fact to be noted is that all the railroad bridges described, with the exception of the Charles River Bridge, which is a bridge for electric traction, are built with solid arch rings, rib construction not being used. However, with the use of larger spans the rib method of construction is bound to come into use on account of the decrease in dead loads to be carried in this type of construction. It is safe to say that within a few years, railroad arch bridges built on graceful lines similar to the Larimer Ave. Bridge at Pittsburgh and the Monroe St. Arch at Spokane, Wash., but probably of not such long spans, will be quite common.

The track elevation structures described show how rapid has been the advance toward attractive, permanent and economic bridges of this type. From the Forest Park Bridge in St. Louis to the Spokane Subways of the C. M. & P. S. Ry. is an enormous stride in the economic design and use of concrete in railroad structures.



Larimer Ave. Bridge, Pittsburgh, Pa.

HIGHWAY ARCH BRIDGES.

The Larimer Ave. Bridge, Pittsburgh, Pa.

The Larimer Ave. Bridge, Pittsburgh, Pa., completed in 1912, is rightfully placed at the head of the list of American bridges. There are two other bridges (both highway bridges) in the world of longer span, but they are of much smaller proportions otherwise; namely, in width and height. The longer span bridges are: one at Rome, Italy, with a span of 328 ft.; and the Auckland, New Zealand, bridge of 320 ft. span. The Larimer Ave. bridge with a clear span of 300 ft. 4⅞ in., a width of 50 ft. and a height of 115 ft., can therefore be justly called the largest concrete arch in the world in point of size and third largest in length of span.

The bridge is 670 ft. long with a roadway 30 ft. wide in the center, flanked by cantilevered concrete sidewalks 10 ft. wide.

The arch ribs are five-centered, an approximate parabola, with a rise of 67 ft. and intradosal radii of 186 ft. 1 in., 241 ft. 8½ in., and 216 ft. 10½ in. These ribs are 8 ft. wide and 6 ft. 6 in. deep at the crown and 11 ft. deep at the haunches and are spaced 30 ft. center to center, cross braced at points of spandrel arch columns. The reinforcement of each rib consists of eight 6x4x¾ in. angles latticed together with flat bars to form a deep lattice-girder, with a total section of 55½ sq. in. Although the ribs as designed are subject to compressive stress only, the steel was added to provide an added factor of safety and make the entire structure more rigid.

The roadway girders supporting the reinforced concrete stringers and floor slab, are carried by reinforced concrete columns 19½ ft. centers, resting on the arch ribs, connected at the top by the circular spandrel arches. The sidewalk is supported by concrete brackets at the spandrel column centers. The approach arches have a clear span of 25 ft. and are carried on columns in a manner similar to that of spandrel arches. There are four approach arches at the west end and three at the east end of bridge.

The main piers are of cellular construction with reinforced concrete face walls extending up to sidewalk. The abutments are reinforced concrete U-abutments filled with earth. Ornamental steel hand rails are supported by paneled concrete posts at panel points of spandrels, on the bridge proper, the rail over the abutments being a solid paneled concrete wall.

The surface finish of this bridge is very fine as shown by the illustration. The main surfaces were bush hammered and other parts were rubbed with carborundum bricks.

This structure is a very graceful and attractive one in every way. The ornamental copings, hand rails and the excellent proportioning and finish of the bridge as a whole, as well as the various parts, gives it an artistic appearance not possessed by many arches. As an example of economic and esthetic design it stands without peer.

Compared with the first concrete arch bridge built in America (in 1893), the Pine Road bridge at Philadelphia, with two 25-ft. spans, one obtains some idea of the progress made in the design of concrete arches in a period of 20 years.

Monroe St. Bridge, Spokane, Wash.

The second largest arch span in America and the fourth in the world is that of the Monroe St. bridge at Spokane, Wash., completed in 1911. This structure is a double track highway bridge, composed of three large arches and a series of small approach arches. The total length of structure is 785 ft., the width 68 ft., with a 50 ft. roadway and two 9 ft. cantilevered sidewalks. The main arch is a twin ribbed segmental arch with a span of 281 ft. and a rise of intrados of 113 ft. 9 in. The ribs are of plain concrete 16 ft. wide at crown flaring to 19 ft. 9 in. at haunches, the thickness at crown being 6 ft. 9 in. The two smaller arches are 120 ft. segmental spans with four ribs, each 6 ft. wide by 3 ft. 3 in. thick at crown, connected in pairs by 6 in. soffit walls. The spandrel and north approach arches are semicircular with spans of 17 ft. to 17 ft. 6 in. with spandrel columns 3 ft. 6 in. thick. The floor system is of structural steel encased in concrete. The roadway is at a height of 130 ft. above the water at center line of main arch. The piers of massive concrete rest on basaltic rock.

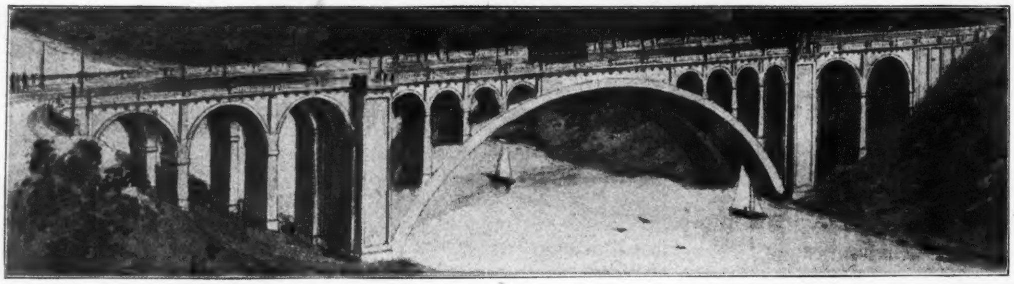
The decoration though simple and limited to reveals and panels on piers and ornamental concrete hand rails, is very impressive and pleasing. Ornamental arched roof shelters at piers add to the beauty of this magnificent structure. It cannot be truthfully said that esthetic requirements were not satisfied in this design. The setting, in a rocky gorge, near a fall in the river, is ideal for an arch of this type and it ranks with the most artistic and beautiful concrete bridges in existence.

Monroe St. Bridge, Spokane, Wash.

Rocky River Bridge, Cleveland, Ohio.

The third largest arch span in America is that of the Rocky River bridge near Cleveland, Ohio. The main arch of this structure which is a highway bridge 108 ft. long and 60 ft. 4 in. wide, has a span of 280 ft., just 1 ft. less than that of the Monroe St. bridge at Spokane, Wash. Besides the 280 ft. span, there are three 44 ft. approach arches at one end and two of same size at the other.

The main arch ribs, two in number, are of plain concrete 22 ft. wide by 11 ft. thick at the springing line tapering to



Rocky River Bridge, Cleveland, O.

18 ft. width and 6 ft. depth at the crown, spaced 34 ft. c. to c. These ribs are three-centered with 164 ft. 6 in. radius, 55 ft each side of crown and a 158 ft. 7¼ in. radius at ends, with a rise of 73 ft. 8 in. The main arch abutments are founded on shale rock and are surmounted by heavy concrete piers, in two parts, with hollow spaces in interiors, carried to top of structure. These piers are of a size in keeping with the rest of the structure and give it the proper architectural balance.

The roadway slab of reinforced concrete is carried by two solid spandrel walls on each rib for 50 ft. each side of the crown, from this point to the piers, four 21 ft. spandrel arches carry the floor. These arches consist of two reinforced concrete ribs tied together by a 6 in. slab.

The approach spans consisting of four ribs each, tied together in pairs, are reinforced over the extrados at haunches and at intrados for 9 ft. on each side of crown. These ribs are three-centered arches 2½ ft. thick and 4 ft. wide at crown, and 3 ft. thick and 5 ft. wide at springing line. A concrete handrail made up of concrete spindles and heavy concrete rail with heavy posts over spandrel piers adds to the beauty of the structure.

The architectural treatment of piers, spandrel and approach arches is in perfect harmony with the size and general outlines of the bridge, even though the approaches to the main arch vary in length, the symmetry and balance of the structure is preserved by more massive retaining walls at the end of shorter approach. All exposed concrete surfaces have a granolithic mortar finish and were washed and rubbed after removing forms, to expose the aggregate, thus rendering a very pleasing surface.

Walnut Lane Bridge, Philadelphia, Pa.

The Walnut Lane bridge over the Wissahickon creek, Philadelphia, Pa., completed in 1908, is a highway bridge which until recently was the longest single concrete arch span in America. It now ranks fourth in size. This bridge is 585 ft. long and 60 ft. wide, consisting of a main arch of the three-centered type with 232 ft. span and 70 ft. 3 in. rise, and two 53 ft. circular arches at one end and three at the other.

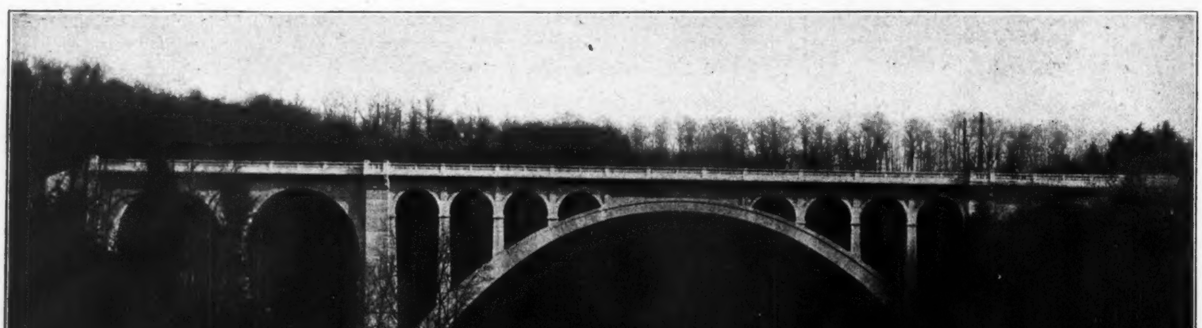
The main arch is composed of two ribs, 21 ft. 6 in. wide and 9 ft. 6 in. thick at the haunch and 18 ft. wide and 5 ft. 6 in. thick at the crown, carried on abutments of solid concrete below springing line and divided, same as ribs, above this. The ribs are of plain concrete, and support concrete pillars which carry spandrel and cross arches, forming an open arch spandrel. The small approach arches have solid spandrels, a crown thickness of 18 in. and an exposed arch face 2 ft. 3 in. thick. The floor system is carried on I-beams carried by the cross spandrel walls.

The ornamental coping is surmounted by a concrete hand rail with pedestals and pilasters cast in place, and balusters cast in molds and erected later. This structure, designed to harmonize with the wild country round about, is a fine example of a happy combination of engineering and artistic design, and is perhaps one of the most graceful and picturesque structures in the world.

The Meadow St. Arch Bridge, Pittsburgh, Pa.

The first large arch bridge to be erected by the city of Pittsburgh was the Meadow Street Arch over Negley Run, built in 1910 at a cost of $72,000. This structure is 454 ft. long and 50 ft. wide with 10 ft. cantilevered sidewalks.

The main span of 209 ft. is a five-centered arch, approaching very closely a parabolic curve with a rise of 46 ft. This arch is made up of three ribs, tied together by horizontal struts 1 ft. wide to brace the structure laterally. The outer



Walnut Lane Bridge, Philadelphia, Pa.

ribs are 3 ft. 9 in. wide and 5 ft. deep at crown and 6 ft. 2 in. deep at springing line. The middle rib is 5 ft. wide and of same depth as outer ribs. The line of pressure in main arch ribs coincides very closely with the axis line, and therefore they were designed without taking account of the reinforcement, which was added to obtain a more uniform distribution of loads and prevent cracking of concrete. The ribs are reinforced with eight 1½ in. grooved bars latticed in pairs and curved to fit the arch curve. The cross struts are reinforced in a similar manner.

The reinforced concrete roadway slab with expansion joints at piers and abutments is supported by the arched spandrel girders, carried by spandrel columns 15 ft. centers resting on the arch ribs. The sidewalks are carried by curved brackets cantilevered from spandrel girders. The main piers are of cellular construction above the haunches of ribs, and solid below. They are 37 ft. 9 in. long and 14 ft. wide. The three approach arches at each end are circular arches with a span of 21 ft. carried on reinforced columns. The abutments are "U" shaped, of cellular reinforced concrete construction. The hand railing is an ornamental iron bridge railing carried by ornamental concrete posts spaced to conform with spacing of spandrel columns. All exposed surfaces were rubbed with emery stone and washed with water several times as soon after pouring as the forms could be removed, a pleasing surface finish being thus obtained.

This bridge, of same type as the Larimer Avenue arch, is an ideal one for the location, over a deep ravine, in a residence district of the city. The artistic features, embodied in the treatment of piers, the arched spandrels carrying the cantilevered sidewalk with ornamental hand rail, also the treatment of approach arches, are in perfect harmony with the graceful and bold outlines of the arch ribs.

Atherton Ave. Bridge, Over the P. J. R. R., Pittsburgh.

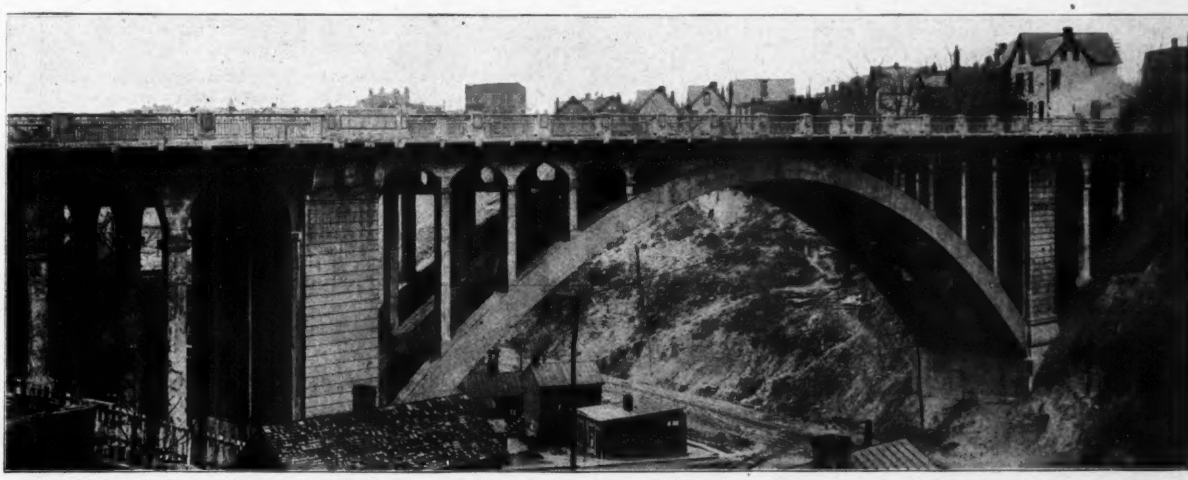
The Atherton Avenue bridge over the Pittsburg Junction R. R., just completed, is another structure of pleasing and effective design built by the city of Pittsburgh. This bridge is 418 ft. 4 in. long over all, made up of a central span of 168 ft. 6 in. with a 32 ft. 6 in. rise, and one approach span of 60 ft. with 14 ft. 8 in. rise and another of 45 ft. with 11 ft. 4⅜ in. rise.

The large span is a three-centered arch made up of two ribs of a uniform width of 14 ft. and a thickness at the crown of 3 ft. 6 in. and 5 ft. 8 in. at the springing line, 37 ft. 6 in., c. to c. The reinforcement of each rib consists of ten 4x4x¾ in. angles, latticed with 2¾ x ⅜ in. flats. Open spandrel arches are used at ends of main span with solid walls at the middle, with pilasters at points where posts would be. The smaller arches have twin ribs of the same width and same distance apart as those of main span, reinforced in a similar manner. The piers are solid up to springing line

Atherton Ave. Bridge, Pittsburgh, Crossing the Pittsburgh Junction Ry.

of main arch ribs and open above, dividing the pier into two parts 18 ft. 6 in. wide.

The arch rings are grooved so as to present the appearance of ring stones or voussoirs. A similar method is used to imitate quoins on piers and abutments. An ornamental concrete hand-rail of fitting design with paneled posts and rails gives the structure a finished appearance. This structure is noted for its bold but graceful outlines, the elliptoid curves of side arches and similar treatment of main arch aiding greatly in producing this effect. The contrast between this structure and the Larimer Avenue bridge is the use of false joints to give a rustic effect to the structure instead of smooth surfaces as used in the latter structure. These bridges are fine examples of ribbed arches and indicate the possibilities in concrete arch design.

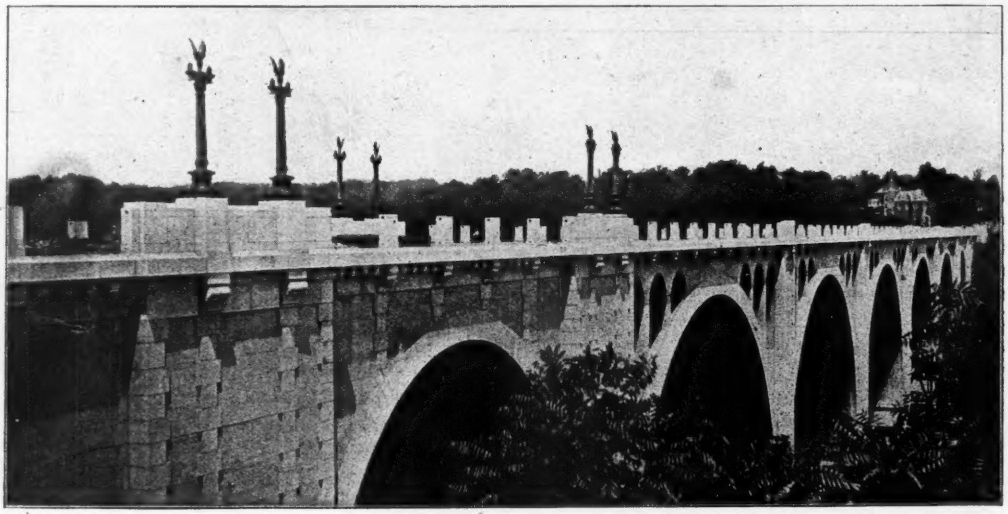


Meadow St. Arch, Pittsburgh, Pa.

Connecticut Ave. Bridge, Washington, D. C.

The Connecticut Avenue bridge at Washington, D. C., is one of the largest plain concrete arch highway bridges in the world, being 1,341 ft. long and 52 ft. wide, composed of five 150 ft. full-centered arch spans and two 82 ft. full-centered spans, one at each end. This structure is built of a combination of molded concrete block and monolithic concrete masonry, a type of construction very rarely used.

Open transverse spandrel arches support the roadway slab over large arches. The spandrels of the smaller arches are solid curtain walls. The arch rings are of monolithic concrete without reinforcement, with faces of voussior shaped, molded concrete blocks. The thickness at the crown is 5 ft. for 150 ft. arches and 3 ft. 3 in. for smaller arches.



Connecticut Ave. Bridge, Washington, D. C.

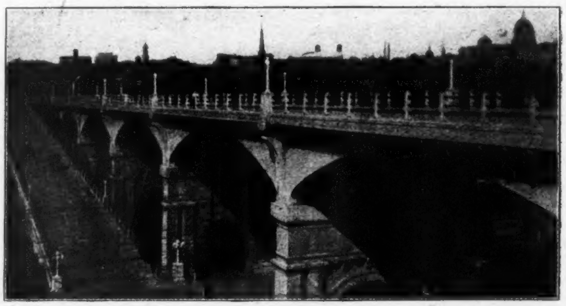
The piers are of solid concrete to springing line of arches and of cellular construction from there to top, which is covered by an arch. The abutments are hollow, U shaped, with walls having vertical faces and stepped backs. All trimmings on the bridge below the bottom of coping, that is, belt courses, quoin, chain and ring stones, brackets and dentils are concrete blocks cast on ground and set in place like cut stone. The total cost of structure, erected in 1905, was $850,000, the item of dressing the surface with hand and pneumatic tools being very high.

This bridge is, of course, somewhat more elaborate than most structures, having been built by the government, no money being spared in making it one of artistic beauty. It is a fine example of the possibilities of plain concrete in arch design and is a companion structure to the famous Walnut Lane bridge, also of plain concrete.

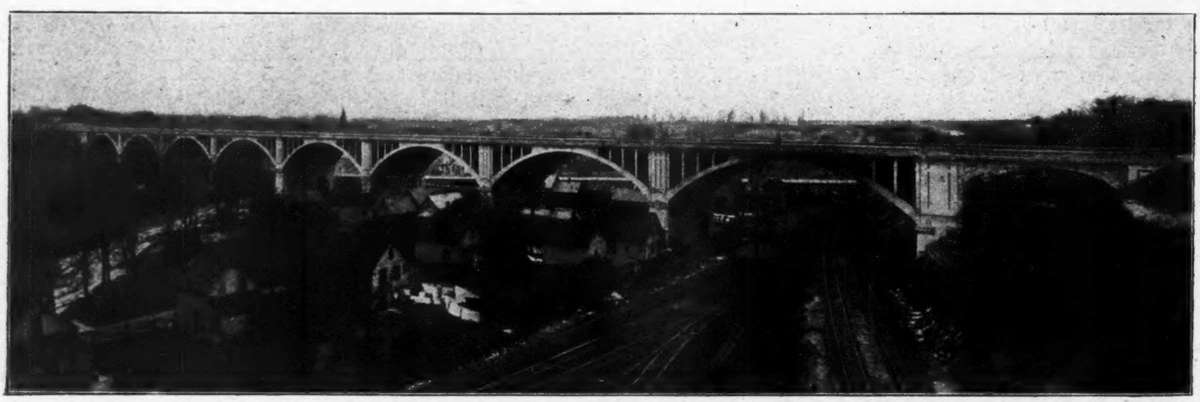
Grand Ave. Viaduct, Milwaukee, Wis.

The Grand Avenue viaduct at Milwaukee, Wis., completed in 1910, carries Grand avenue over several railroad tracks and streets in the Menomonee River Valley. This structure is 2,088 ft. long, 80 ft. above the river and 67 ft. wide over all, with a 40-ft. roadway and two 10-ft. walks. The bridge is composed of eight segmental arches of 143-ft. span, with a rise of 28 ft. and two small arches of 80-ft. and 60-ft. spans. The main arches are 2 ft. 2 in. thick at the crown and 6 ft. thick at piers, reinforced with Melan system built-up truss ribs of 3x3x3/8-in. angles latticed together with 2 in. by 1/4 in. bars. The spandrels are of the open arch transverse type, carrying the roadway slab, except for 30 ft. on each side of crown, where the spandrel wall is solid. The arch piers are 14 ft. thick and 65 ft. wide, with two arched openings 15 ft. wide and 30 ft. high in each pier to lessen the dead load.

The architectural design of this bridge is not very ornamental, but is indeed very effective and artistic, the only ornamentation being the belt courses at tops of piers, with paneled pilasters above, surmounted by lamp posts. Between piers is a balustrade resting on a simple molding of massive sections of scroll design, with a lamp post at center of span.



Mulberry St. Viaduct, Harrisburgh, Pa.



Grand Ave. Viaduct, Milwaukee, Wis.

Grand River Bridge, Lake Shore & Michigan Southern Ry.

Mulberry St. Viaduct, Harrisburg, Pa.

The Mulberry Street Viaduct is a highway structure across Tenth and Cameron streets, Harrisburg, Pa., and 27 tracks of the Pennsylvania R. R. Co. and the Philadelphia & Reading Ry. It is 1,841 ft. long, 44 ft. wide and 60 ft. high, with an inclined side approach of 600 ft. The main viaduct is composed of seven segmental arches of 96 ft. clear span and twelve arches, varying from 40 to 85 ft. span resting on reinforced arch piers of an elaborate design, penetrating to bedrock 30 ft. below ground. The approach consists of four segmental arches of 96 ft. clear span and one short arch. The abutments are of cellular contruction filled with sand.

The 96 ft. arches in main viaduct, 100 ft. center to center of piers, consist of four reinforced concrete ribs 2 ft. wide, 18 in. deep at crown and 17 ft. deep at skewbacks, spaced 12 ft. on centers, the intrados being a three-centered curve of 100 and 140 radii with a 14 ft. rise. The other arches are of similar construction. The reinforced concrete roadway slab is carried by cross beams supported directly on the arch ribs and projects about 4 ft. beyond the outer arch ribs forming a part of the 8 ft. sidewalks. The inclined approach is of similar construction, but is narrower and the arches have three ribs instead of four.

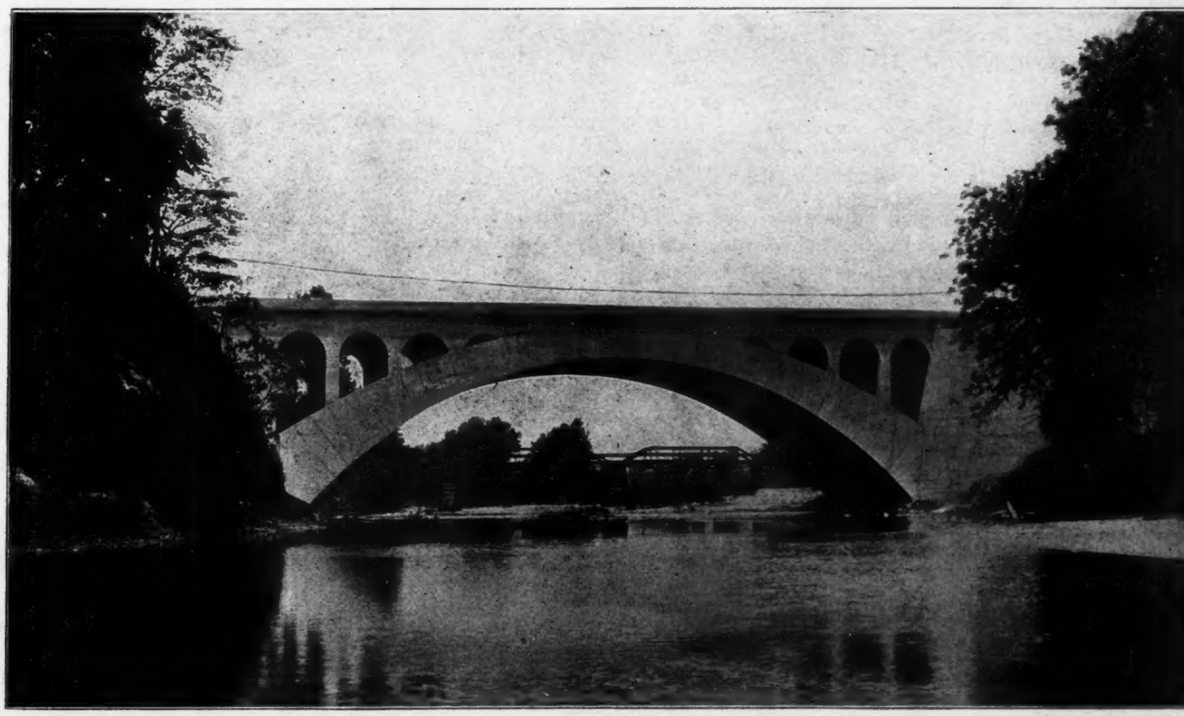
The decorative features of this structure are very fine. The projecting sidewalks are strengthened by corbeled brackets, alternate brackets being about twice the size of the others. At each alternate large bracket is placed a concrete fence post 6 ft. high to carry the pipe hand rail. At the piers the false corbeled column supports a heavy post, which in turn carries an ornamental lamp post. The various copings and brackets on piers are an important part of the general architectural treatment of the bridge.

The cost of this structure was about $260,000, or about the same as for a steel viaduct on masonry piers, which in no way could have compared in artistic beauty with the structure as built.

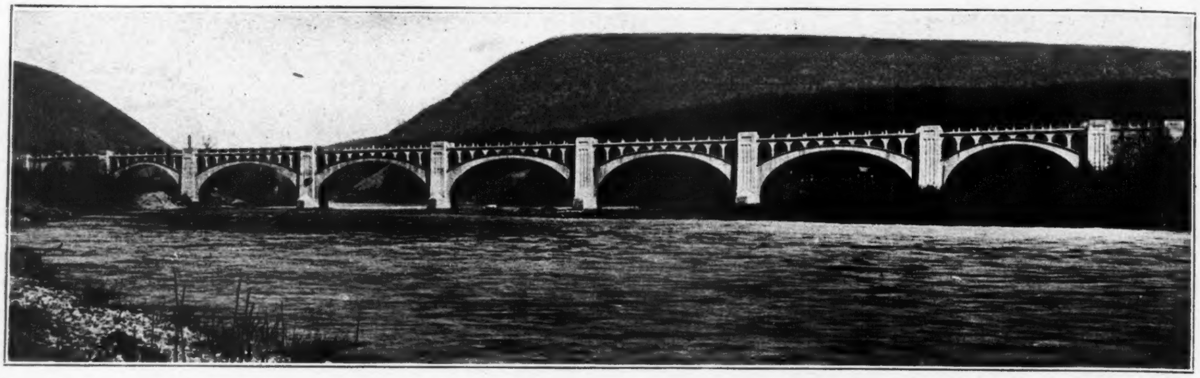
RAILWAY ARCH BRIDGES.

Grand River Bridge, L. S. & M. S. Ry.

The L. S. & M. S. Ry. bridge over the Grand River, near Painesville, Ohio, is a four-track reinforced concrete three-span arch bridge, of which one arch span is 160 ft. in clear,



Willoughby Run Arch, L. S. & M. S. Ry.



Delaware River Bridge, Delaware, Lackawanna & Western R. R.

making it the largest concrete arch in railway service. The structure is 401 ft. long, with transverse open arch spandrels carried on walls of reinforced concrete 3 ft. thick, supporting the deck slab.

The central arch of 160-ft. span is of the circular segmental type, with a radius of 84 ft. ¾ in. at the intrados and a rise of 71 ft. 6 in., carried on monolithic concrete piers. These piers are 17 ft. wide and 71 ft. long, founded on a dense shale. The two end arches, with a span of 69 ft. 8¼ in., have an intradosal radius of 37 ft. 6 in., rest on abutments, consisting of five buttress walls tied together by reinforced crosswalls. The end arches are full centered for the half next to the main arch and segmental for the other half. All arches are so designed as to be independent of each other, any one being entirely stable in case of failure of the other two.

These arches, although very nearly safe when considered as plain concrete arches, are reinforced both longitudinally and transversely at intrados and extrados. The main arch is 7 ft. 3 in. thick and end arches are 4 ft. 6 in. thick at the crown.

The corbeled parapet wall of reinforced concrete is an integral part of the floor slab. The spandrel cross walls are kneebraced to the floor slab, except at spandrel openings, where a jack arch, extending 5 ft. back from face of wall, was placed in order to give the structure a more balanced appearance.

This bridge represents good engineering practice in heavy concrete arch construction and, although comparatively plain, presents a fine architectural appearance, due to the symmetry and balance of proportion of the structure. The fact that the central span is so much larger than the end spans accounts for the massive beauty of this structure, not to be found in a bridge of three spans with arches of the same or nearly the same span.

Willoughby Run Arch, L. S. & M. S. Ry.

The largest single arch span in railway service is the Willoughby Run arch built by the L. S. & M. S. Ry. over the Chagrin River at Willoughby, Ohio, in 1904. The structure is a four-track reinforced concrete arch of 153 ft. clear span and a rise of 33 ft. 8¾ in., with open arch spandrels carrying the reinforced concrete deck slab.

The arch ring, with circular segmental intrados of 103 ft. 8 in. radius, has a crown thickness of about 7 ft. 6 in. The reinforcement consists of corrugated bars placed longitudinally and transversely near extrados and intrados of arch. The faces of arch ring have false voussoir marks to imitate ring stones. The spandrel walls, floor and parapets are integral and are of reinforced concrete. The parapet has a projecting molded coping. The entire structure is of very plain but effective design, the massiveness of the structure being relied upon for its attractive beauty.

Delaware River Bridge, D. L. & W. R. R.

The largest concrete arch bridge in railway service, as regards span and number of arches, is the double-track bridge across the Delaware River on the new Hopatcong-Slateford cut-off of the D. L. & W. R. R. It was completed in 1911 at a cost of $591,000.

This structure is 1,450 ft. long and 64 ft. high, composed of nine reinforced concrete arches of varying spans, crossing the river at an angle of 65°. The five 150 ft. elliptical arches 6 ft. deep at crown and 15 ft. at the haunch are reinforced with 1¼-in. cold twisted square bars 2-ft. on centers at extrados and intrados longitudinally, and 1-in. bars, 3-ft. centers, transversely in extrados and intrados.

Little Wabash River Bridge, Illinois Central R. R.

The intradosal curves are ellipses, with a major axis of 150 ft. and a semi-minor axis (rise) of 40 ft. The extrados is an ellipse, major axis 200 ft., semi-minor axis 46 ft. The 120-ft. arches, two in number, are elliptical, with an intradosal curve, the major axis of which is 120 ft., the semi-minor axis (rise) being 40 ft.; the extradosal curve is the segment of a circle, with 128-ft. radius. These arches are reinforced the same as main arches, being 5 ft. 4 in. deep at the crown and 14 ft. at the haunch. The two 33-ft. semi-circular arches with solid spandrel walls are at one end of the bridge, one over the highway and the other over the old main line, and located on a curve which resolves the arch over the highway into a 53-ft. elliptical span and the other into a 50-ft. elliptical span along the center line of viaduct. The smaller arch rings are reinforced at extrados and intrados with 1-in. square bars 12-in. centers longitudinally, and ½-in. square bars 2 ft. centers transversely.

The larger arches have open circular arch spandrels of 13-ft. clear span, extending from pier to pier, carried on reinforced concrete walls 3 ft. thick. The floor slab is 1 ft. thick at crown of spandrel arches, reinforced with 1-in. square bars 6-in. centers longitudinally, and 1-in. bars 2 ft. centers transversely. The hand rail is of 3 in. galvanized wrought iron pipe, with concrete posts 16 ft. c. to c.

The piers are of solid concrete 25 ft. wide on skew and 48 ft. long on center line of pier, with 45-degree cutwater at both ends, the exposed edges protected by granite quoins on upstream end. The batter on sides of piers is ¾ in. to the foot, except on cutwater at upstream end, which has a 2-in. batter.

The abutments of the last 120-ft. arches are carried 7 ft. below surface, are 40 ft. long and are given firm bearing on solid rock by means of two concrete caissons 9 ft. wide, 40 ft. long and 46 ft. deep. The section of abutment 8 ft. deep, immediately over the caisson, was designed as a reinforced concrete slab to transmit load to caissons.

U-shaped retaining walls are used on the east approach of viaduct. The walls have a common base and are stepped up to about one-third of the total height of wall (60 ft. high). At this point heavy struts, with sufficient reinforcement to resist the horizontal earth thrust (a maximum at this point) tie the two walls together. Above this the walls are designed as reinforced cantilevers.

The elliptical arches of graceful outline, supported by the massive paneled piers, give the structure an exceedingly beautiful architectural appearance not possessed by very many railroad structures of even smaller size.

Big Muddy River Bridge, Illinois Central R. R.

A three-span double-track, arch bridge built in 1903 by the Illinois Central R. R. over the Big Muddy river, near Grand Tower, Ill., represents one of the first large railroad bridges of plain concrete. The structure is 34 ft. 2 in. wide and 483 ft. long, made up of three 140 ft. span elliptical arches with a radii of 167 ft. at the crown and a rise of 30 ft. The arch rings are 31 ft. wide and 7 ft. thick at the crown, and 20 ft. thick at the springing lines. Each arch is surmounted by ten transverse spandrel arches of reinforced concrete, whose abutment walls are pierced by longitudinal arches. The arch rings were laid in voussoirs and false voussoir marks were made in the face of arch rings. The piers and abutments are of mass concrete up to the haunches of the arches. Above this the piers are hollow, made up of reinforced concrete slabs forming a half hexagon with inlaid panels and parapet walls above the coping to form retreats. The abutments are of the U type with heavy paneled pilasters next to arch.


Big Muddy River Bridge, I. C. R. R.

This bridge and the Watson (Ill.) bridge mark the beginning of the use of open spandrels for railway structures. They were adopted in these cases after considerable study had been made as to the advantages of open and closed

spandrels, the former being chosen on account of less load to be carried by arch ring and foundations. The general outline of this structure is very pleasing, the elliptical arches with open spandrels having graceful and effective lines, which are in harmony with large details and simple moldings. The entire treatment is in keeping with the requirements of a structure such as this.

Little Wabash River Arch Bridge, Watson, Ill.—Ill. Central R. R.

The double-track, twin arch bridge over the Little Wabash River, near Watson, Ill., built in 1902, bears the distinction of being the first concrete arch bridge for railroad service with spans of more than 100 ft.

This structure, built of plain concrete, is 376 ft. long and 34 ft. 2 in. wide. The arches of 124 ft. clear span are of plain concrete laid in voussoirs with grooves at faces to give the appearance of ring stones. The arch rings are 4 ft. 6 in. thick at the crown and 12 ft. 6 in. thick at haunch, with an elliptical intrados having a rise of 30 ft.

The transverse spandrel arches, with a span of 9 ft., are carried by heavy cross walls 2 ft. thick. The spandrel arches, with a crown thickness of 1 ft., form the deck which carries the fill and ballast. The parapet walls are of plain concrete with corbeled copings.

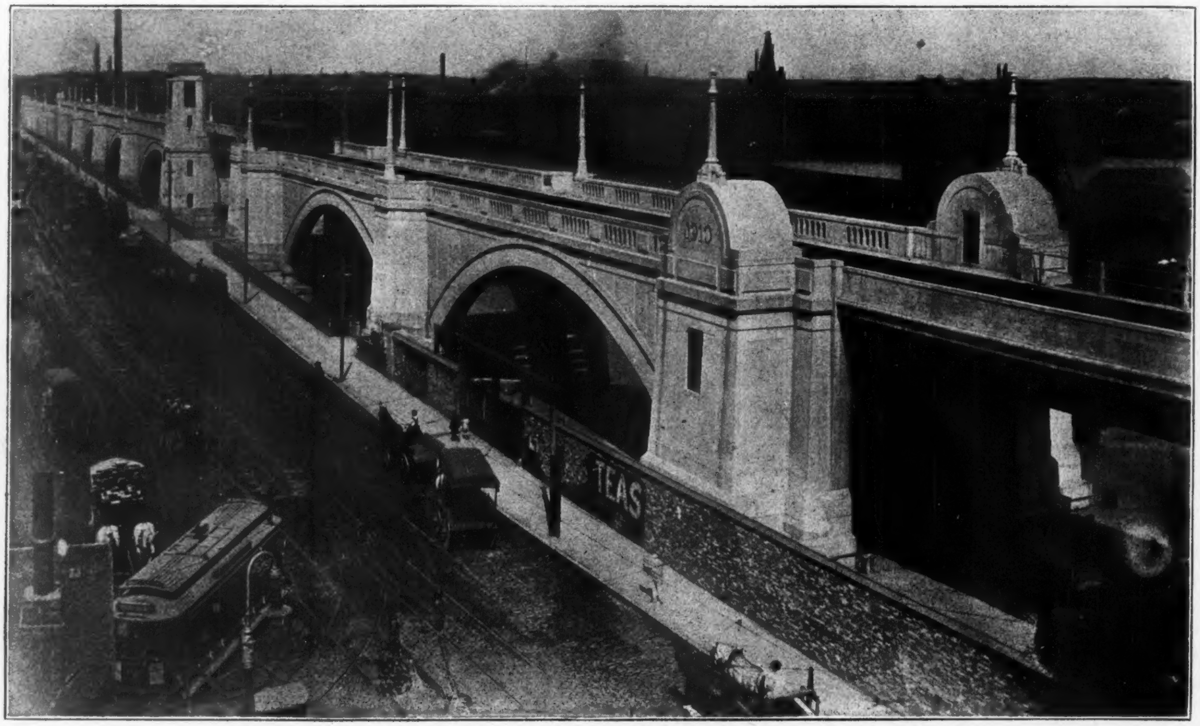
The intermediate pier is of solid plain concrete 16 ft. wide and 52 ft. long up to haunches of arches; above this it is of hollow construction, with arched top and paneled facings. The "U" abutments are of the gravity type with 56-ft. wings. Heavy projecting pilasters, with inset panels at ends of abutments, are of same style as those on center pier. All exposed faces have a facing of cement mortar placed at time of pouring concrete. The general architectural treatment is simple and massive, but nevertheless the bridge has a graceful and attractive appearance, especially for a heavy structure, and it refutes the statement that nearly all early concrete bridges are unsightly and inartistic.

Charles River Bridge, Boston, Mass.

The Charles River Bridge (1912) of the Boston Elevated Ry., between Boston and Cambridge, is 1,740 ft. long and 33 ft. wide, made up of five segmental arches of 122 ft. 4 in. clear span, four of 98 ft. 4 in. span, a single span bascule bridge, a special 125 ft. 4 in. span at the small boat lock and a steel girder span encased in concrete at the Cambridge end of the bridge.

The piers are founded on solid blocks of concrete resting on piles and faced with granite up to springing lines of arches. All piers, with the exception of two, have an opening 25 ft. wide, normal to center line of bridge, separating the piers into two parts, which are of hollow, reinforced concrete construction above the arch ribs at springing. These bastions are connected by arched floorbeams at the top.

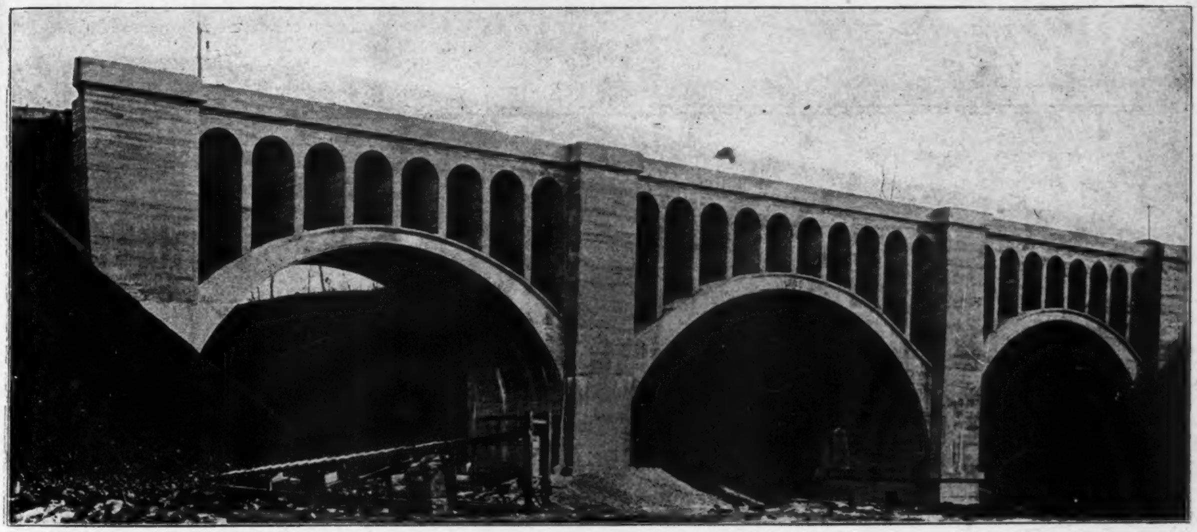
The arches consist of two reinforced concrete, two-hinged ribs, 29 ft. center to center, 4 ft. wide and 4 ft. 6 in. thick at crown, and 6 ft. thick at springing line. The arches all have a rise of 19 ft. 4 in., with a circular segmental intrados. The reinforcement consists of twelve 1¼ in. corrugated bars near intrados and extrados. An open floor system, consisting of steel I-beam stringers carrying track rails, are embedded in concrete, framing into concrete cross girders of a heavy T-section, constructed with arched bottoms for architectural reasons.



Charles River Bridge, Boston, Mass.

The spandrel walls are of reinforced concrete, a wall being placed on both sides of arch ribs, thus leaving a hollow space over the ribs under the sidewalks.

The lines and proportions, the details of design and perfection of finish of this structure and harmony with environments, are truly remarkable. The illustration by no means conveys the beauty as brought out by the different surface finishes employed. The shape and paneling of piers, the ornamental balustrades, belt courses and cornices are architectural features which make this a most graceful and beautiful structure.



Vermillion River Bridge, Big Four Ry.

Paulin's Kill Viaduct, D., L. & W. R. R.

A large railway bridge of seven arch spans of good engineering and artistic design is the Paulin's Kill Viaduct on the D. L. & W. R. R. This structure, an illustration of which appears in the Concrete Department heading, depends upon its major features and general arrangement and symmetry for its beauty rather than on elaborate ornamentation. A short description of this bridge was given on page 514 of the November (1912) issue. It will be remembered that the length of the bridge is 1,100 ft., made up of five circular reinforced concrete arches of 120-ft. span and two of 100-ft. span, with open arch spandrels from pier to pier.

Vermillion River Bridge, Big Four Ry.

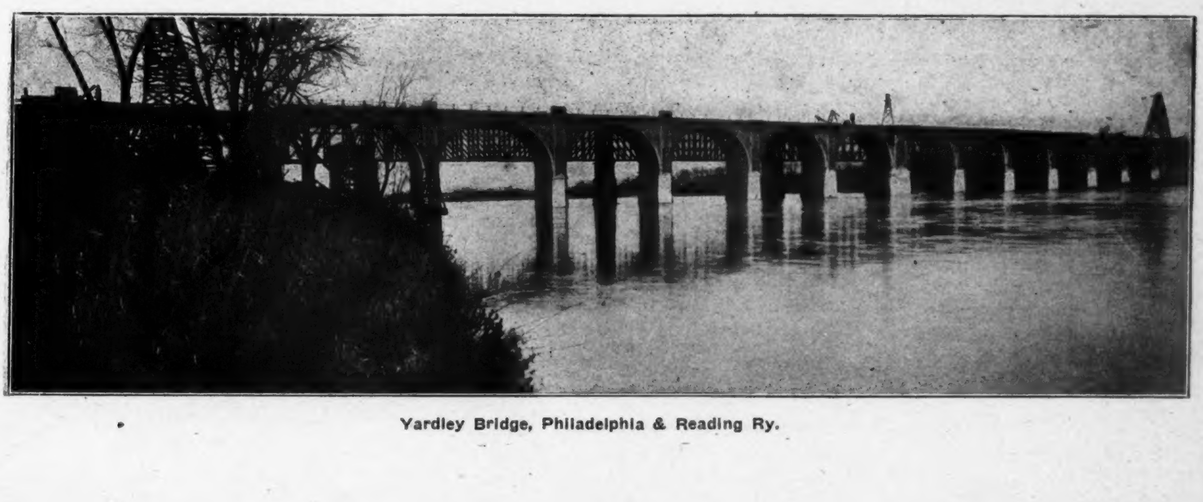
The Vermillion River Bridge, on the C., C., C. & St. L. Ry., erected in 1905, is a reinforced concrete arch bridge of three spans, with transverse open arch spandrels from pier to pier.

The central span is a 100-ft. segmental arch with 40-ft. rise. The end spans are 80 ft., with 30-ft. rise. The arch rings are 3 ft. 6 in. thick at the crown, deepening out toward the springing lines, and are reinforced longitudinally and transversely near the extrados and intrados. The piers are of mass concrete below the arch rings and hollow above, the pilasters being carried up as reinforced facing slabs 15 ft. wide and 3 ft. 6 in. thick. The transverse walls are formed by the piers of the spandrel arches next to the springings. The reinforced concrete deck slab and parapets retain the track fill and ballast. The arch rings are paneled, and a projecting coping is placed on the spandrel walls, otherwise the bridge is very plain. This type of bridge, with open spandrels from pier to pier, is adapted to bridges of considerable height, but does not appear as graceful when used in structures with low piers. In the latter case a bridge with closed spandrels at middle portion of span and open arched spandrels at ends presents the best and most effective appearance.

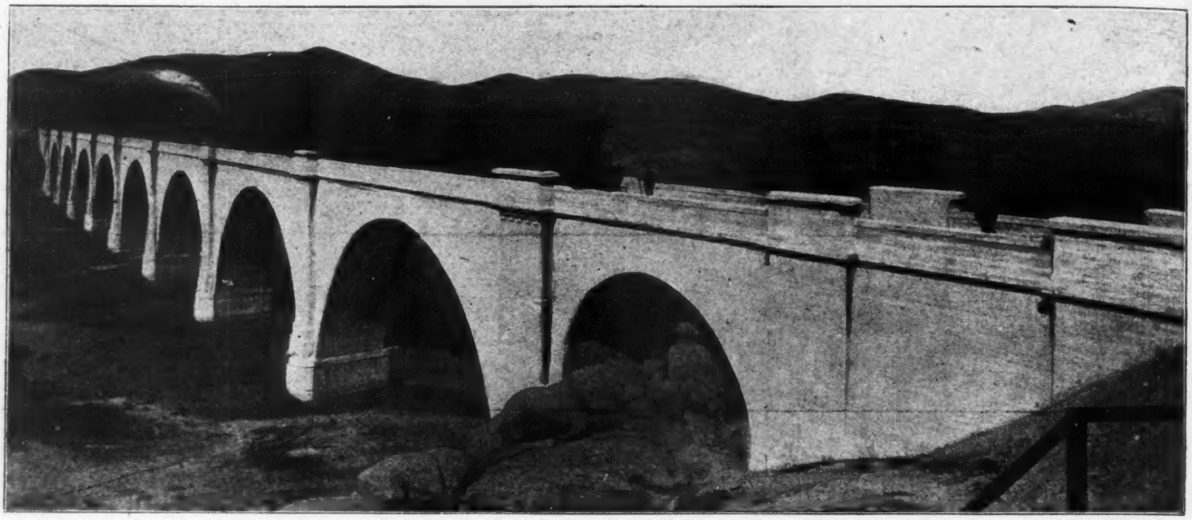
Yardley Bridge, Philadelphia & Reading Ry.

The Yardley Bridge of the P. & R. Ry. over the Delaware River at Yardley, Pa., completed in 1912, has a total length of 1,445 ft. 6 in., composed of eleven arches of 90 ft. 9 in. span and three arches of 85 ft. 11 in. span. The structure is 33 ft. wide, for a double-track line, and the height is 70 ft. above mean low-water level. The arch rings are of the five-centered type, with a 35-ft. rise, a crown thickness of 3 ft. 6 in. and a radial thickness of about 10 ft. at the haunch. The arch rings are reinforced transversely and longitudinally near extrados and intrados of arch.

The piers, resting on rock, are 20 ft. wide, 36 ft. long above springing line, lengthening out below this line to 56 ft. at top of footing. The spandrel walls are reinforced concrete retaining walls, retaining a stone fill and ballast. The spandrel has a projecting beveled coping and is surmounted by a two-pipe hand rail of concrete posts and 4-in. iron pipes. The projecting pilasters of piers above springing



Yardley Bridge, Philadelphia & Reading Ry.



Santa Ana River Bridge, San Pedro, Los Angeles & Salt Lake R. R.

lines are paneled, and the spandrels near piers have triangular panels. The arch ring with beveled edges projects slightly beyond spandrel walls.

The general appearance and lines of the structure give an exceedingly pleasing appearance, the simple decoration of piers, spandrels and arch rings emphasizing the massive beauty of the bridge. The engineering design and construction of this structure represent the latest practice in this type of bridge.

Santa Ana River Bridge, San Pedro, Los Angeles & Salt Lake R. R.

The plain concrete arch viaduct of the San Pedro, Los Angeles & Salt Lake R. R. over the Santa Ana River, near Riverside, Cal., built in 1903, is a fine example of the early type of plain concrete railway bridge with solid spandrels.

The length of this structure is 984 ft., with an average height of 55 ft. The bridge is composed of eight circular arches of 86-ft. span, with 43 ft. 6 in. rise and two 38 ft. 6 in. approach spans, with 19 ft. 3 in. rise.

The arch rings are 3 ft. 6 in. thick at the crown and 5 ft. thick at the haunch. These arches rest on piers and abutments of solid concrete 15 ft. by 27 ft. 6 in. long. The projecting pilasters of the piers and abutments are carried up above the top of parapet wall and are capped by a heavy projecting coping. The spandrel walls are plain concrete gravity walls, retaining the earth fill and ballast. The projecting belt courses, with brackets at the pier pilasters, and the prominence given the piers by these projecting pilasters greatly enhances the massive beauty of this structure.

Big White Lick Creek Bridge, Big Four Ry.

An example of a large arch bridge of three equal spans is the double-track structure of the C., C., C. & St. L. Ry. over Big White Lick Creek, near Terre Haute, Ind., built in 1906. This bridge, although very plain and free from paneling or other surface treatment, is a remarkably attractive structure, due to the symmetry and excellent proportion of the various parts.

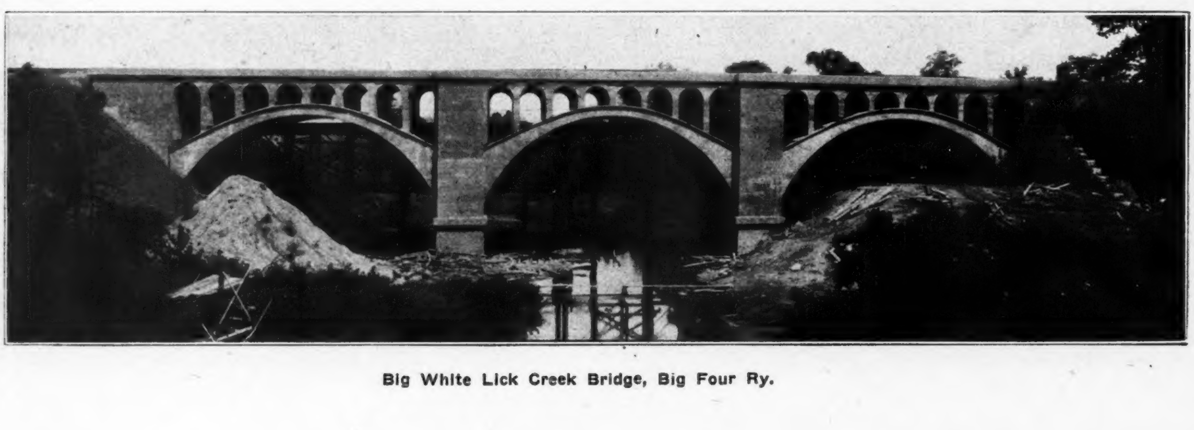
The arch rings are of reinforced concrete, a method of reinforcing similar to that of the Vermillion River Bridge being used. The arches are proportioned as plain concrete rings, with the reinforcement put in to tie the structure together and to care for any unbalanced loadings or settlement. The span of arches is 75 ft. and the rise is 28 ft. The curve of the intrados of arches is a segment of a circle, with 41-ft. radius, and the thickness at the crown is 3 ft. 3 in.

The reinforced concrete deck slabs are carried by the transverse spandrel walls, the tops of openings being formed into circular arches of 7 ft. 4 in. span. The parapet walls to retain ballast have a corbeled coping. The piers are of solid concrete to the haunches of arches and of hollow construction above. The "U" abutments are of the gravity type, with gravity wing walls.

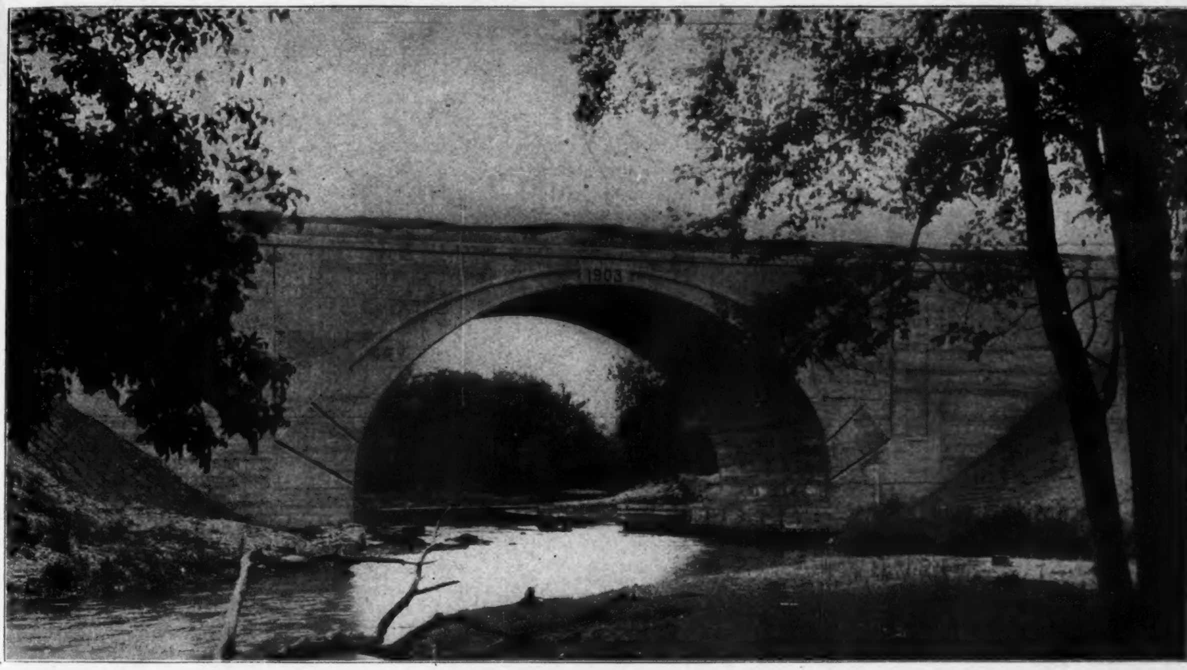
Plano Arch, C., B. & Q. R. R.

The Plano Arch over Big Rock Creek, on the C., B. & Q. R. R., built in 1903, is a fine example of a single arch, double-track railway bridge of reinforced concrete, with plain but artistic lines.

The arch ring is of the three-centered type, with 75-ft.



Big White Lick Creek Bridge, Big Four Ry.



Plano Arch, Chicago, Burlington & Quincy R. R.

span, 3 ft. thick at the crown and reinforced with transverse and longitudinal bars near intrados and extrados, although the arch ring is strong enough as a plain concrete arch. The radius of middle portion of intrados is 43 ft., while the end portions next to abutments have a 20-ft. radius. This structure, 212 ft. long and 44 ft. wide, was erected under traffic, being constructed around the old deck trusses, which were afterward cut out and the holes filled with concrete. The old bridge piers were made a part of the new abutments. The spandrel and wing walls are plain gravity sections. The surface treatment is confined to paneling of pilasters above the abutments at points of location of old piers, a projecting coping and a delineation of the arch ring by means of panels and grooves. This is a comparatively inexpensive and attractive treatment for such a structure, with solid spandrel walls retaining an earth fill.

CONCRETE GIRDER RAILROAD BRIDGE.

French Broad River Viaduct, Southern Ry.

The largest reinforced concrete girder bridge in America for railway service is the French Broad River Bridge on the Southern Ry. between Asheville and Cragg, N. C., completed in May, 1910.

This bridge, on a 30° skew, is 733 ft. 10 in. long and 30 ft. wide, consisting of twenty-two girder spans 30 ft. in the clear, resting on reinforced concrete piers founded on solid rock. The bottom of girders are 12 ft. above low water level in river and 8 ft. above maximum high water.

There are three lines of continuous girders 13 ft. 4 in. on centers, cross braced by transverse beams at middle of span, and carrying a reinforced concrete floor 2 ft. thick between. The heavily reinforced girders (0.8 per cent reinforcement

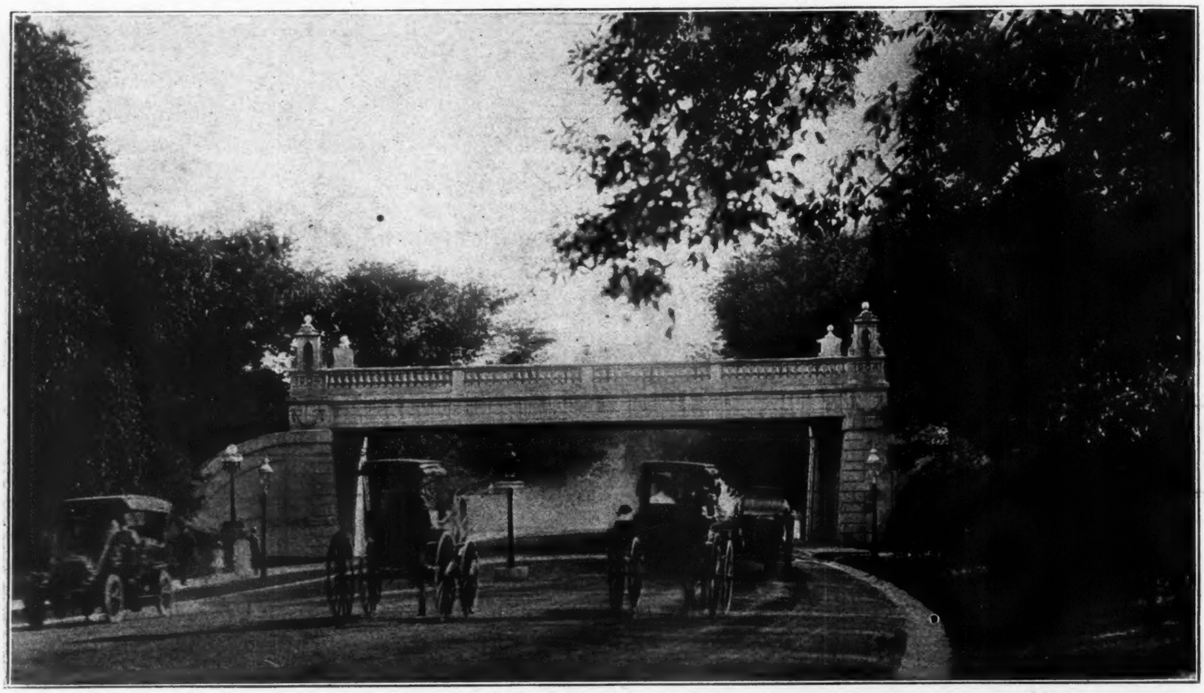
French Broad River Viaduct, Southern Ry.

used) are 9 ft. 7 in. deep, the center one being 3 ft. wide and the outer ones 2 ft. wide. The tops of girders are about 2 ft. above top of slab, the outer ones forming parapets with projecting coping. Expansion joints are provided on all piers at springing lines of girder fillets.

The first two piers at each end are 3 ft. thick at top, the third pier and every fourth thereafter are 4 ft. thick, the intermediate piers having a top thickness of 3 ft. The monotony of the structure is broken by carrying the heavier piers to the top of coping as pilasters, thus dividing the structure into units of three spans at the ends and of four spans between. The fascia girders are paneled between piers and the tops of smaller piers are capped with projecting beveled caps. The girders are joined to piers with fillets of about 3-ft. radius.

The "U" abutments at the ends have horizontal groove course marks about 1 ft. apart instead of panels.

This type of structure is adapted to wide and shallow crossings, and this particular one is a fine example of a very satisfactory architectural treatment for a girder bridge.



Forest Park Bridge, St. Louis, Wabash R. R.

STEEL AND CONCRETE TRACK ELEVATION BRIDGES.

Forest Park Bridge, St. Louis, Wabash R. R.

The Forest Park Bridge, St. Louis, Mo., built in 1904 by the Wabash R. R., represents one of the first track elevation structures in which concrete was used to improve the appearance of an unsightly steel structure. The bridge, located in one of St. Louis' parks, has a clear span of about 80 ft., which necessitated a steel plate girder structure. The city officials required the railroad to erect a bridge which would be in harmony with the surroundings, and after much consideration it was decided to use paneled concrete fascia girders and ornamental concrete balustrades.

The structure, which is for double-track service, consists of three plate girders about 8 ft. deep on 15-ft. centers, with a reinforced concrete floor carried on 15-in. I beams. The fascia girders and the balustrades are carried by steel brackets connected to the outer girders. The abutments are of hollow, reinforced concrete construction, with curved, paneled wing walls. At the connections of wings to abutment face; the concrete is blocked off to represent quoin stones. The treatment of the abutments greatly enhances the beauty of this bridg, which certainly is a credit to the designer and those concerned in its construction. The concrete fascia girders were constructed at a cost of $1,000, which is a paltry sum when one considers how much the structure is beautified by this addition.

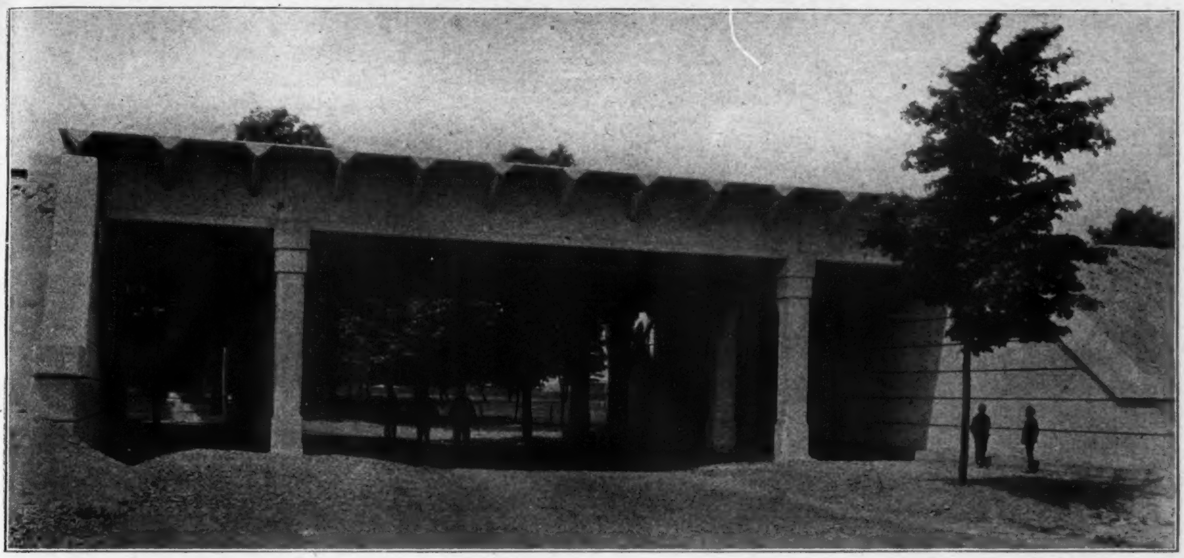
Cedar Ave. Bridge, Cleveland, O.

The Cedar Ave. Bridge, on the Cleveland Short Line Ry., built by the N. Y., C. & St. L. Ry. in 1901, is in the residence district of East Cleveland, and for this reason was made somewhat ornamental to be in harmony with its surroundings.

This structure is a plate girder span with concrete floor, treated so as to give the appearance of a concrete arch bridge of two spans. In order to do this, light circular ribs of steel angles were riveted to the bottoms of girders at the abutments to form the curve of a flat arch, and then covered with concrete. The fascia girders of concrete are molded to give the appearance and lines of arches, with arch rings, belt courses, spandrels and an ornamental balustrade to hide the tops of steel girders. The intermediate columns at middle of roadway are covered with concrete to form the pier of arches. The abutments are of plain concrete, paneled to harmonize with the rest of the structure. The surface of concrete was rubbed with carborundum to give a smooth surface. This treatment of steel track elevation structures presents extensive possibilities in artistic design, as is forcibly brought out by the beauty of this bridge.

Track Elevation Bridge, Bristol, Pa., Penn. R. R.

The Bristol, Pa., track elevation structure of the Pennsylvania R. R., illustrated, is a four-track, through plate girder span entirely encased in concrete. The steel columns supporting the trusses are jacketed with concrete and decorated by use of corbeled tops and transverse curved brackets. The



Bristol, Pa., Track Elevation Bridge, Pennsylvania R. R.

fascia girders are paneled and support a cantilevered walk, supported by steel brackets covered with concrete. The grooved horizontal course marks in the straight abutments are in keeping with the general lines of the structure. The whole design presents a very satisfactory solution of the problem of the decoration and protection of steel track elevation structures.

Cedar Ave. Bridge, Cleveland, O.

The Independence Blvd. Bridge, B. & O. C. T. R. R.

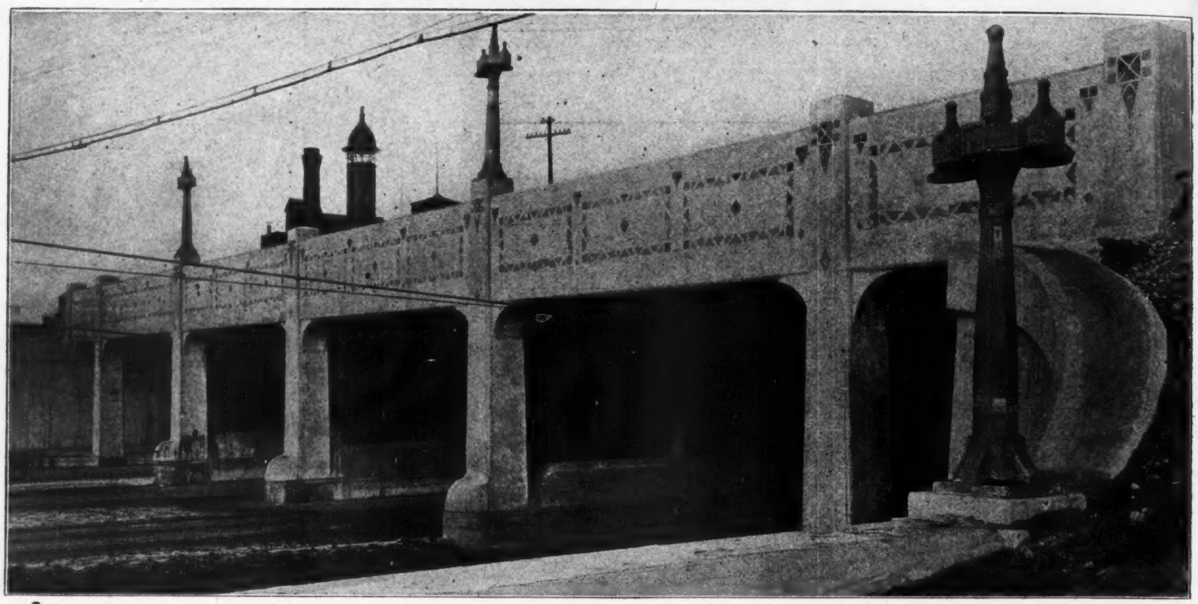
The finest track elevation structure in the city of Chicago is without doubt the B. & O. C. T. R. R. bridge across Independence Boulevard, completed in October, 1912. This bridge, described in detail in the October (1912) issue, is a steel plate girder bridge 250 ft. long, consisting of nine spans encased in concrete in such a way as to give the structure the appearance of a series of flat concrete arches supported by narrow concrete piers. The beauty of this bridge is not attained by the use of a great deal of ornamentation and paneling, but by the corbeled coping, large buttressed columns or pylons of the roadway spans, the smooth rubbed concrete surface finish and the symmetry and balance of proportion of the structure as a whole.

Ogden Ave. Viaduct, B. & O. C. T. R. R.

The Ogden Ave. Viaduct of the B. & O. R. R. over Ogden Avenue Boulevard, Chicago, completed in 1911, is a steel plate girder structure, the portals of which are encased in concrete. The fascia girders are decorated with red, blue and yellow Moravian tile instead of the usual paneling used in such a structure. Curved abutment wings, with ornamental lamp posts at the ends, are one of the architectural features of the bridge. Two lamp posts are placed at about the third points of the structure over columns. A detailed description of this viaduct was given in the June (1912) issue.

Although the general appearance when viewed from a distance is good, it cannot be said that the treatment is all that could be desired when seen at close range. The tile were grouted in panels left in concrete at time of pouring, and this cement grout has since cracked a great deal. This seems to be the great fault with this type of architectural treatment for railway bridges, which, by the way, is more expensive than any other method of treatment herein described.

Independence Boulevard Bridge, B. & O. C. T. R. R.



Ogden Ave. Viaduct, B. & O. C. T. R. R.

Sacramento Boulevard Bridge, B. & O. C. T. R. R.

The wide diversity of designs which can be obtained by the use of concrete in the construction of track elevation structures is exemplified by the three structures of the B. & O. R. R. in Chicago, illustrated here. The Sacramento Boulevard Bridge is, like the others, a plate girder structure on steel columns, with I-beam floor covered with concrete slab. The concrete fascia girders, however, are given an altogether different treatment.

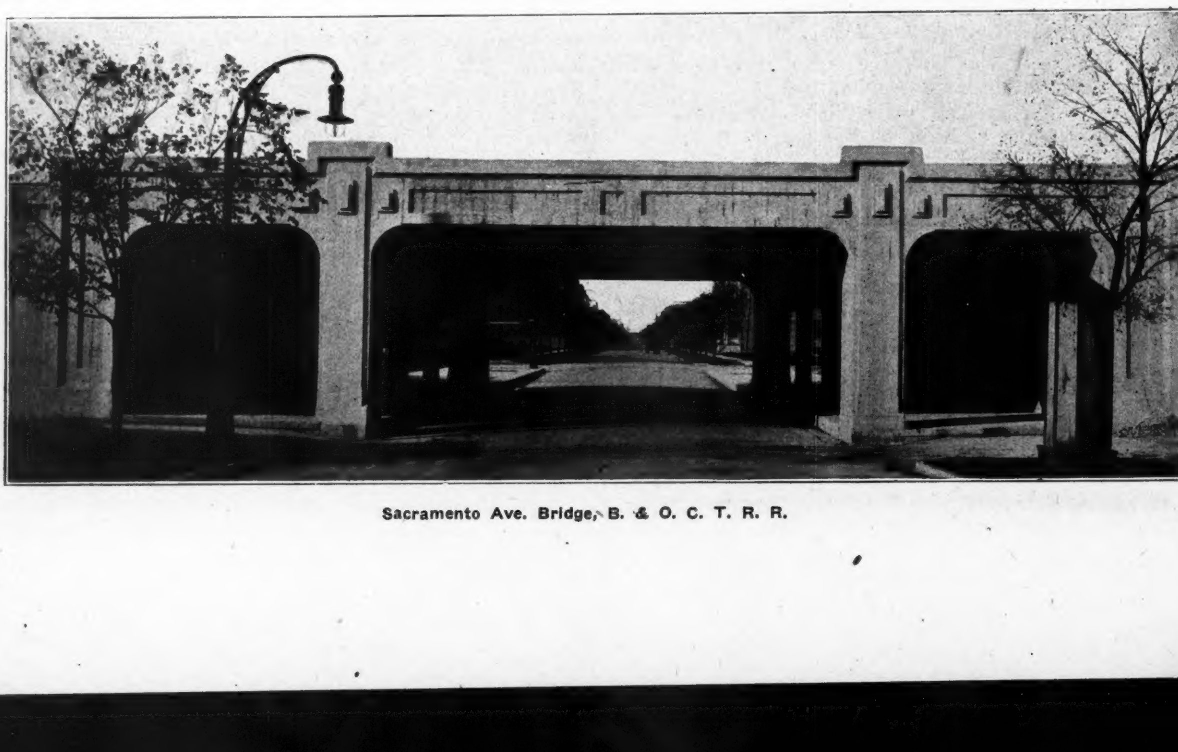
The general architecture is of the Mission order, and the application of this style to a railroad structure is quite unique. The fascia girders are ornamented with inset panels and raised block medallions near the piers, to which they are joined by curved fillets. The projecting coping is raised above piers to give prominence to the same, which are rather massive, with raised face panels and medallions near the top, in line with those on girders. The abutments have an inset panel with the coping carried down square to ground line at the ends, thus giving the structure a very graceful and finished outline. It is doubtful if another track elevation structure of the same size can be found which presents a more pleasing appearance.

PLAIN AND REINFORCED CONCRETE TRACK ELEVATION BRIDGES.

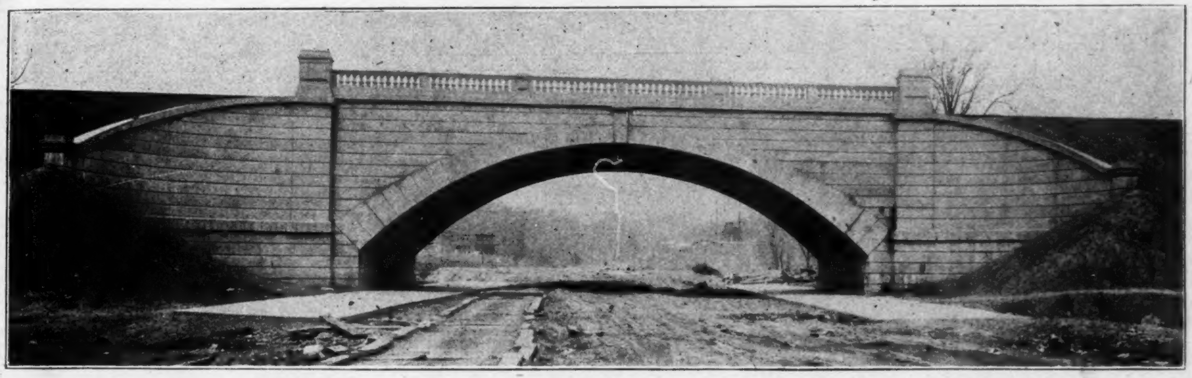
Belfield Ave. Bridge, Phila. & Reading Ry.

A track elevation structure of unusual design is represented by the plain concrete arch bridge of 80 ft. span built by the Philadelphia & Reading Ry. over Belfield Ave., Philadelphia. This three-track bridge was built in an earth embankment, which originally closed the street, without interrupting traffic.

The plain concrete arch ring, which is circular segmental, has a rise of 16 ft. 11 in. and a thickness of 3 ft. 6 in. at the crown and 8½ ft. at springing. The arch ring was cast in voussoirs across the width of arch. The abutments are of mas-



Sacramento Ave. Bridge, B. & O. C. T. R. R.



Belfield Ave. Bridge, Philadelphia, Pa., P. & R. Ry.

sive concrete with curved wing walls. The spandrel walls are plain, gravity walls, surmounted by an ornamental hand rail of reinforced concrete.

All exposed surfaces are of white pebble granolithic mortar scrubbed to expose the pebbles which, with the grooved horizontal course marks on spandrel and curved abutments give the structure a very fine appearance.

Chicago Track Elevation Bridges, Ill. Cent. R. R.

The Ill. Central R. R. track elevation bridges, built in 1908 and 1909 in the city of Chicago, are entirely of reinforced concrete and are in general 130 ft. wide, with four spans, two of 25 ft. and two end spans of 10 ft. The deck slabs were cast in yards, hauled to the site and placed on the reinforced concrete piers, composed of columns on cylindrical piers and capped at the top with a girder arched between columns. The main slabs are 6 ft. 3 in. wide and 2 ft. 10 in. deep, weighing 33 tons. The end slabs were cast in place, together with coping and false arches, a pocket being provided in abutments and a seat on end of piers from which to spring the false arches. These false arches give the structure an appearance of two flat arches for roadway spans and two circular arches at walks. Although plain and without decoration, these bridges are more pleasing to the eye than structures of steel.

Bristol, Pa., Concrete Subway, Penn. R. R.

The reinforced concrete four-track bridges of the Pennsylvania R. R., built in 1910 at Bristol, Pa., were the first long span slab bridges built by this railroad. Three structures 50 ft. long and 52 ft. wide were built. The roadway spans are 31 ft. center to center of columns, with slabs 3 ft. 5¼ in. thick and 13 ft. wide. The sidewalk span slabs are 10 ft. long and 16½ in. thick. These slabs were designed to be cast in yards and set in place after curing, but at Bristol they were built in place on account of transportation difficulties. The outside slabs are paneled and grooved and have a projecting parapet and coping to retain ballast.

The reinforced concrete columns, four for each bent, are spaced 13 ft. centers, resting on a continuous footing and connected at the top with a continuous girder with arched connections of 4 ft. 6 in. radius. The outside columns have a circular bracket extension of the cross girder to support the slabs. They are 4 ft. wide and 2 ft. thick in a line parallel to center line of track. Panels and belt courses are used in the architectural treatment of columns. The abutments are of plain concrete, with groove course marks or

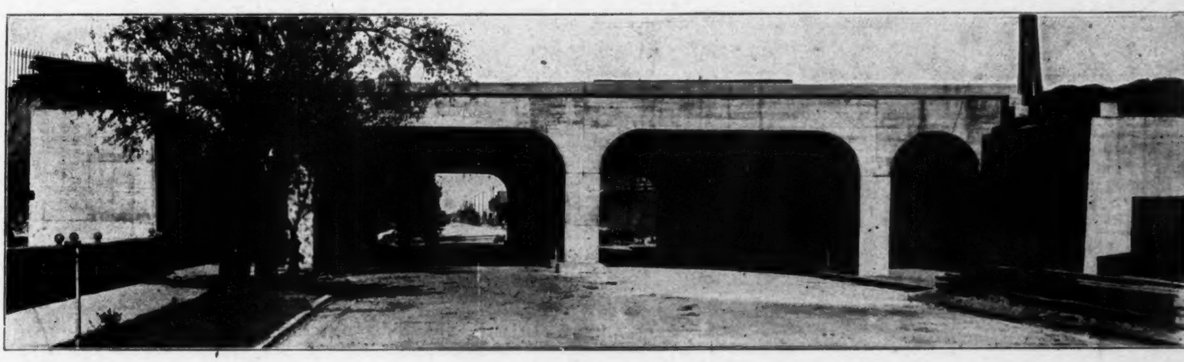
Concrete Subway, Bristol, Pa., Penn. R. R.

scoring and projecting coping connecting with that of slabs. The bridges were rubbed with carborundum brick to obtain a smooth-surface finish.

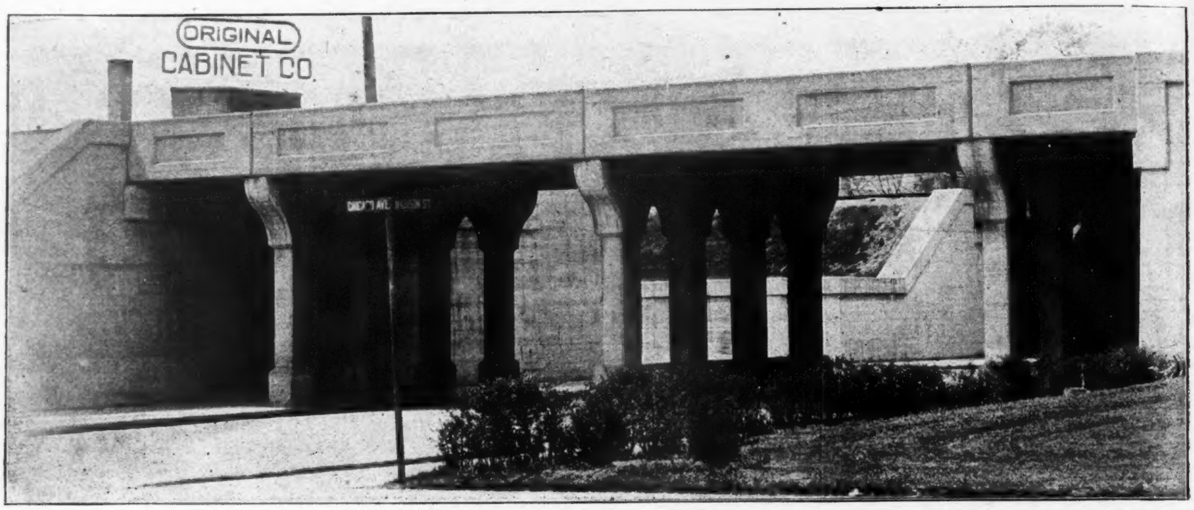
These structures are fine examples of reinforced concrete track elevation structures, resembling very closely the C., M. & St. P. Ry. bridges at Evanston, Ill.

Evanston Subways, C., M. & St. P. Ry.

The track elevation bridges of the C., M. & St. P. Ry. at Evanston, Ill., thirteen in number, were built in 1909. They are composed of reinforced concrete slabs 13 ft. wide,



Chicago Track Elevation Bridge, Illinois Central R. R.



Madison St. Subway, Evanston, Ill., Chicago, Milwaukee & St. Paul Ry.

cast in yard and set in place on reinforced concrete piers. The piers are composed of four columns connected at top by a cross girder arched between columns, resting on a continuous footing of reinforced concrete. These bridges have in general two sidewalk spans of 8 ft. 6 in. from abutments to center line of columns and two roadway spans of 24 ft. 6 in. center to center of columns, thus placing a pier at center of roadway.

The roadway slabs are 2 ft. 9 in. thick, with a 1 ft. 3 in. curb at sides to retain ballast; the parapet walls thus formed are paneled. The abutments are of heavy plain concrete, giving the structures the requisite massive appearance. The piers were designed with an idea of making them appear as light as possible, so as not to have the subways appear like tunnels. The curved brackets on the outer columns and the arches between columns add to the appearance of these structures, which are good examples of track elevation bridges built entirely of concrete.

Spokane Subways, Chicago, Milwaukee & St. Paul Ry., Puget Sound Line.

The typical track elevation structures of the C., M. & St. P. Ry. at Spokane, Wash., illustrated here, are remarkable because of their departure from the main features of reinforced concrete slab bridges heretofore used.

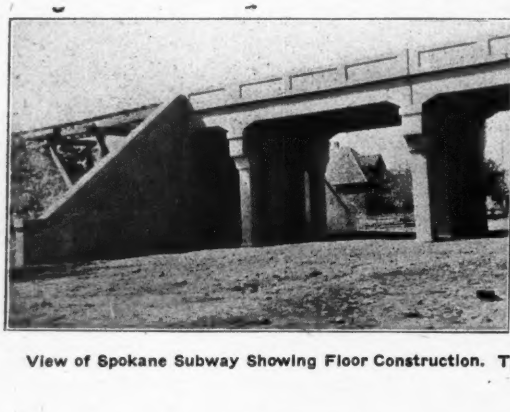
The superstructure is a T-beam slab, with a large reduction in dead load moment and shear over the usual solid slab. The permanent load on the piers and foundations is greatly lessened in consequence thereof. These savings result in a decided reduction in cost, as well as a very desirable effect of lightness and artistic beauty.

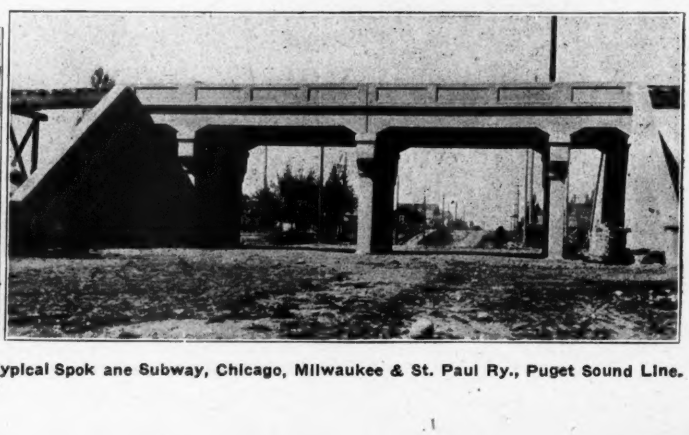
These T-beams spaced 2 ft. centers have a total depth of about 3 ft. 9 in. for a span of 25 ft. The stems are 10 in. thick and are crossed braced at various points. The flanges of the T's are 9 inches thick. The upper part of the parapet is paneled and projects over the lower part, which is, in fact, the face of the stem of the outside T-beam. This break in the fascia and the brackets at ends of T-stems gives a general appearance of lightness to the structures.

The piers are of light construction of reinforced concrete posts on a continuous footing, connected at the top by a series of small circular arches reinforced as a continuous girder. The details of tops of piers is very well worked out, the top being given a bevel toward sides, so as to protect the edges from excessive pressure caused by slight deflections of slab under load. Failure to provide for this excess pressure has caused unsightly cracks and otherwise damaged many concrete piers on other track elevation projects. A plain coping around tops of piers gives them a finished appearance. The straight abutments are buttressed walls of reinforced concrete of light section, which preserve the general appearance of lightness so characteristic of these structures.

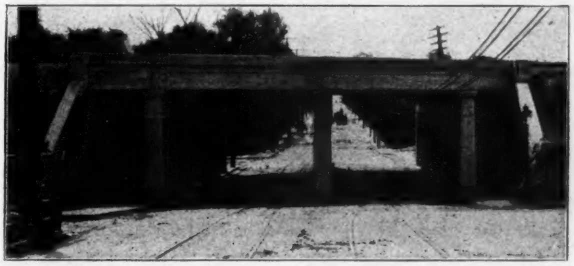
These bridges demonstrate that reinforced concrete structures can be built without a costly or elaborate scheme of decoration and still preserve a utilitarian and pleasing architectural appearance. The attractive and graceful lines of these bridges are the result of a combination of best engineering practice, with experience gained from the behavior of similar structures in service.

The Spokane bridges are without doubt the most advanced type of reinforced concrete track elevation structures, and are also without doubt artistic enough for any residence





View of Spokane Subway Showing Floor Construction. Typical Spokane Subway, Chicago, Milwaukee & St. Paul Ry., Puget Sound Line.



Jackson Ave. Subway, Kansas City Terminal Ry.

Greensville Arch, D. L. & W. R. R.

district. They are indeed a credit to the engineering department of the railway and to the city.

Jackson Ave. Subway, Kansas City Terminal Ry. Co.

The Jackson Ave. Subway, Kansas City, Mo., on the Kansas City Terminal Ry., represents the typical track elevation structures being used in the new Union Station and terminal work at Kansas City.

These bridges differ from the other concrete structures described in that the columns, cross girders and floor slabs are all cast in yards and erected by derrick cars. The square reinforced concrete columns, with exception of ones at end of each bent, are built with a taper of about ½ in. in 12 in. and have a beveled cap at the top. The cross girders, in general, about 14 ft. long and 2 ft. 6 in. wide and 4 ft. 6 in. deep, are placed upon the columns, and then the slabs are placed on the girders. The end columns have no cap, but the top of the end cross girder is cast with a cap, thus giving the subways an appearance of increased height. The center columns rest on individual footings of plain concrete, while the sidewalk columns rest on continuous reinforced concrete footings.

The large floor slabs are 5 ft. wide, 3 ft. thick and 27 ft. long and weigh about 40 tons. Special slabs, with a projecting parapet wall and paneled face, are placed at sides. The slabs for sidewalk spans are made much thinner. All slabs and cross girders are reinforced with deformed bars. The abutments with straight wings are plain gravity walls.

These structures, although not as artistic and attractive as some others illustrated, are fine examples of "unit" construction of all parts, which no doubt is a step toward economic design and construction of track elevation bridges.

OVERHEAD HIGHWAY BRIDGES.

Greensville Overhead Arch, D. L. & W. R. R.

The Greensville overhead highway arch on the Slateford-Hoptacong cut-off of the D. L. & W. R. R., built in 1911, is an unusually large and attractive structure of this class.

The total length of the bridge is 181 ft. 6 in., the width is 22 ft., and the clearance above tracks at the crown is 22 ft. 6 in. This arch, with a span of 83 ft. 3 in. on a 45° skew, has a rise of 16 ft. The arch ring, which is 2 ft. thick at the crown, is reinforced at intrados and extrados with ¾-in. square twisted bars, 12-in. centers longitudinally and 2-ft. centers transversely. The curve of intrados of arch ring approximates an ellipse, being five-centered, with radii of 111 ft., 55 ft. and 10 ft. 10⅛ in. The extrados is a segment of a circle with a radius of 140 ft. The spandrel wall is a solid gravity wall with ½-in. square bar stirrups, 2-ft. centers, in wall over arch ring from top of coping to intrados of arch ring. The abutments are plain concrete gravity walls of the "U" type. The (cast in place) concrete hand rail, which is plain but artistic, gives the structure a very fine appearance. There are several other highway bridges of this same type on this line, and they are all fine examples of concrete work.

Kinsman Road Bridge, Cleveland Short Line R. R.

Kinsman Road Bridge, Cleveland, Ohio.

At Kinsman Road, Cleveland, Ohio, on the Cleveland Short Line, is a special type of overhead skew highway bridge which is very rarely used in track depression work. This structure, over six tracks, is a combination steel and concrete arch bridge with floor system suspended from the arch ribs.

The span of ribs is 100 ft. and width of bridge is 66 ft. 6 in. The two concrete arch ribs, 5 ft. wide and 5 ft. thick at the crown, are of segmental type with an intradosal radius of 52 ft. The reinforcement for these ribs consists of a steel framework of four latticed ribs made up of angles. The ribs were hinged at skewbacks and at crown during construction, but were concreted up afterward. The floor beams are carried by five suspenders made up of pairs of eye-bars attached to each rib, and encased in concrete.

The floor slab is of reinforced concrete over steel beams. By twisting the eye-bars the skew of the bridge is taken up, so that the main floor beams are parallel to track center line. The abutments are of mass concrete. The sidewalks are on the outside of the ribs, and are carried by cantilevered floor beams. The ornamental, paneled balustrade (a steel lattice girder encased in concrete) adds to the appearance of this unique structure. The entire concrete surface was finished by rubbing with carborundum brick. The photograph does not do justice to this structure, which is, in fact, rather attractive.

Monroe St. Bridge, Brookland, D. C.

The Monroe St. Bridge at Brookland, D. C., a suburb of Washington, is an overhead highway bridge of somewhat unusual design. This structure, which carries Monroe St.

Monroe St. Bridge, Brookland, D. C.

over the Baltimore & Ohio R. R. tracks, consists of steel Howe trusses, with a span of 60 ft. (measured on the skew) encased in concrete.

The steel trusses themselves are 61 ft. 5½ in. long and 6 ft. 10½ in. deep, the concrete protection making the girders 7 ft. 7 in. high and 2 ft. wide. These girders are placed 15 ft. each side of center line of bridge and carry a concrete sidewalk slab 6 ft. 6 in. wide, supported on steel brackets on the outside. The concrete roadway slab 30 ft. wide is carried by floor beams encased in concrete, placed at panel points of trusses, 6½ ft. apart. Heavy iron pipe railings are placed at outer edge of each sidewalk; all other metal used in the bridge is encased in concrete.

The abutments are the most elaborate part of this structure, being "U" abutments of solid masonry with heavy projecting pilasters at the ends. The tops of abutments are surmounted by heavy corbeled copings and concrete parapets forming retreats at the pilasters. Ornamental lamp posts over the end pilasters enhance the architectural features of the bridge.

Acknowledgement.

We are indebted to the following individuals and corporations for photographs and data used in this article. The Pittsburgh bridges, N. S. Sprague, superintendent Department of Public Works; the Monroe Street Bridge, Spokane, Wash., P. F. Kennedy, assistant city engineer; Rocky River Bridge, Cleveland, Ohio, A. M. Felgate, bridge engineer, Cuyahoga Co., Ohio; Philadelphia, Pa., bridges, Henry H. Quimby, engineer of bridges; Grand Avenue Viaduct, Milwaukee, Marquette Cement Co., Chicago which furnished the cement; Atlas Portland Cement Co., photographs of Grand River bridge, Big Muddy River bridge and the Vermillion River bridge, Atlas Portland Cement used; Corrugated Bar Co., photographs of Willoughby Run arch and Forest Park bridge, corrugated bars used; Universal Portland Cement Co., photographs Larimer Avenue bridge, Watson (Ill.) bridge, Ogden and Sacramento Avenue bridges, Chicago, and the Terre Haute Arch bridge, Universal Portland Cement used; G. J. Ray, chief engineer, photographs and data on the D. L. & W. R. R. bridges; C. T. Fernald, engineer, Boston Elevated Ry. Co., data and photograph of Charles River bridge; William Hunter chief engineer, and E. Chamberlain, assistant engineer, photograph and description of the Yardley bridge; E. G. Tilton, chief engineer, data and photograph of Santa Ana River viaduct; C. H. Cartlidge, bridge engineer, C., B. & Q. R. R., photograph of Plano arch; W. H. Wells, chief engineer construction, Southern Ry., photograph of French Broad River viaduct; David Gaehrz, secretary Cleveland Engineering Society, photographs of Kinsman Street and Cedar Avenue bridges, Cleveland, Ohio; the Cement Manufacturers' Association, photographs of Bristol, Pa., bridges; J. H. Prior, engineer of design, photographs of C., M. & St. P. Ry. track elevation bridges, Evanston, Ill.; A. S. Baldwin, chief engineer, Illinois Central R. R., data on the Watson (Ill.) bridge; G. P. Smith, chief engineer, C., C., C. & St. L. Ry., data on the Terre Haute arch.

New Books

FIRE PREVENTION AND FIRE PROTECTION AS APPLIED TO BUILDING CONSTRUCTION.—By Joseph Kendall Freitag. 4½x7; Morocco. 1,050 pages. Published by John Wiley & Sons, New York City. Price, $4.00.

This handbook contains valuable information which is of vital interest to every owner of buildings, the architect, the engineer and the underwriter, and admirably fills a long felt want for a book of this character. The book is divided into six parts: Fire Prevention and Fire Protection, Fire Tests and Materials, Fire Resisting Design, Fire Resisting Construction, Special Structures, and Auxiliary Equipment and Safeguards. No one is so well qualified to write a book on this important subject as is Mr. Freitag, who is a recognized authority on the subject. The first chapter devoted to Fire Losses, gives statistics on fire losses in this country and in Europe, which, without further comment, indicate the pressing need of fire prevention and protection. The merits and demerits of the various types of building construction from the fire prevention standpoint are discussed in a very intelligent manner.

To the owner or prospective builder, the book is invaluable, since it shows how insurance rates are reduced by good construction and protection. The insurance rate on buildings is beginning to be one of first consideration, as it always should have been, but unfortunately was not. The author has adopted a very ingenious method of pointing out the defects and merits of many so-called fire-proof types of construction, by describing and illustrating their behavior in actual conflagrations of such size as to test the structures to the utmost.

With a few minor exceptions, for instance, in the matter of cost data, the book covers its field in such a clear and comprehensive manner and in such interesting style, that no one in the least interested in building construction, can afford to be without it.

The Signal Department

WASHINGTON WATER POWER CO.'S BLOCK SIGNALS.

By Frank C. Perkins.

The necessity of providing in adequate and reliable system of signaling on high speed electric lines, that is, a system that would include first, the greatest possible safety and second, maximum operating efficiency, was recognized by the officials of the Washington Water Power Company's railways at a very early date and they have accordingly made a complete installation on about 20 miles of their single track lines extending between Spokane and the towns of Medical Lake and Cheney in the state of Washington.

There were 29 automatic block signals installed, the scheme being the same as that used on the electric division of the New York Central Railroad's terminal improvements in and around New York City, by the Long Island R. R., New York, New Haven & Hartford R. R., and other lines with the addition of automatic train stops which are not used on any of the lines enumerated.

It is held that this system is no more expensive, from the standpoint of first cost, than those usually adopted for electric lines but it was felt that the additional cost was warranted by the increased safety due to the continuous track control of the signals, and the elimination of the trolley contact and car counting devices ordinarily used (which indicate entrance and exit only) and are incapable of protecting against a car accidentally or maliciously moved from a siding into or fouling the main line, and which are subject to annoying dissarrangement in operation.

It may be stated that with the system adopted, the presence of one pair of car wheels on or fouling the main line at any point within the area protected by a given signal or signals is sufficient to set the signals at the "stop" position and will hold them in that position until the wheels are moved clear of the main line. The same is true if a rail is broken or removed, or if the insulation of a track joint breaks down.

The throwing of a switch in any block section sets the signals protecting that section at stop. No train can pass a "Stop" signal until one of the train crew has cleared the "Stop Arm" in a manner to be explained later, and any attempt to pass without performing this operation results in the automatic setting of the brakes and prevents their release until a glass tube, broken by the unauthorized movement past the signal, has been replaced.

The system provides an overlap control for all signals, that is, the control of all signals by a train is carried to a point beyond the next opposing signal, an arrangement that renders it impossible for two trains approaching each other to meet without one of them receiving a stop signal at least one block away from the other, and provides two stop signals in the rear for the government of the following moves.

The signaling equipment includes the signal mechanism, polyphase relays, and iron core reactance bonds. The cars are operated by 600 volt direct current, which makes it imperative to use alternating current track control for the signal system, in order to secure immunity from interference and false operation of the latter by the former. The 600 volt propulsion current is obtained from motor generator sets supplied from a 60,000 volt 60 cycle line.

The current is available at the Mameison sub-station in approximately the center of the district to be served, and is delivered to the busbars of the signal switch board at 2,200 volts, whence it is distributed to the signal transmission lines through automatically tripped oil circuit breakers equipped with U. T. E. time limit relays and alarm bells. Measuring instruments are also provded for each line.

The transmission lines are each composed of two No. 10 H. D., T. B., W. P., line wires strung on the same poles, and under the main transmission line. This size gives a carrying capacity such that the maximum drop at the end of any line is less than 10 per cent when starting the entire signal system. Transformers stepping from 2,200 volts to the various voltages required are placed at each signal and track feed location and there are high tension lightning arresters installed at approximately half mile intervals for protecton against electric storms.

Oil cooled transformers are used throughout. The 2,200 volt primaries being provided with fuses located in the porcelain containers on the back of the cross arm which supports the transformer. Independent secondary windings are provided for each track circuit, for operating signals, for lighting, and local relay circuits. The fuses and lightning arresters for the above are located in the bottom of the relay boxes.

The track secondary windings are provided with taps ranging from 1.5 to 8 volts so that the required voltage may be supplied to the track circuits of various lengths. The signal secondaries provide 220 volts for signal operation with taps of 55 volts for signal lighting and of 28 volts for the relay local windings; all of which taps are taken to a terminal board for convenient connection to the external circuits.

The polyphase relay used is essentially a two phase induction motor, one phase of which is energized from a transformer located at the relay, and the other through the track circuit, which is energized by a transformer located at a distance. This arrangement provides for the furnishing of the major portion of the energy for operating the relay from a local source with low losses, and requires that only a very small amount of energy shall be supplied through the track where the losses are high. It is remarkable for high efficiency, simplicity of design, high point of drop away current, and for the low contact resistance.

It is claimed that the efficiency is most emphatically proved by the fact that, in this installation, they are operating on continuous track sections, that is track circuits without cut sections, of over fifteen thousand (15,000) feet in length, and in the absence of the best conditions as to ballast and track leakage. This length of continuous track section has never before been equalled or even approached in the signaling art.

The track circuits are arranged, so that both rails are available for the returning propulsion current; 60 A. S. C. E., steel is used for the tracks, which are divided into block sections of from 175 feet to 15,150 feet by means of insulated rail joints and reactance bonds. The joints are for isolating the signal blocks, the bonds for providing a path around the former. The bonds provide a means for the passage of the return propulsion direct current, and obstruct the passage of the alternating signal current from one block section to the next.

The reactance bonds are oil cooled and consist of an insulated copper conductor of suitable carrying capacity wound around an iron core. The ends of the coil are attached to the track rails on the same side of a pair of insulated joints. A center tap from each coil is attached to the center tap of the bond on the adjacent section. This arrangement provides a return path for the D. C. and at the same time a very high reactance between rails for the alternating signal current.

It is held that unbalancing, that is, inequality of return, propulsion current flow in the two rails of a block section, which would tend to magnetize the core and reduce the reactance, is taken care of by the introduction of an adjustable air gap in the magnetic circuit.

The signaling current flowing through the bond when the track is unoccupied creates a difference of potential at the rails, which varies with the length of track section and the impressed voltage. The sections and voltages are always arranged so as

to provide an ample margin over and above the 4 to 10 volts required for the operation of the relays, when using a 60 cycle current.

The signal mechanisms are of the General Railway Signal Co.'s make; clamped to the poles, and arranged for 45 deg. travel of the arm in the upper left hand quadrant. The mechanism is operated by a series wound commutating alternating current motor designed so that it gives sparkless operation, and having the usual high starting torque, low starting and operating current and high efficiency.

The transformer from which the signal receives its power is located one block in advance a distance varying from 175 feet to over 15,000 feet and the signal is operated directly over this line without the use of a line relay.

The longest control in the installation under discussion is about 7 miles with No. 10 copper for both control and common wires. That is, the signal is operating successfully through a total line resistance closely approximately 74 ohms.

There is a centrifugal governor provided on the end of the armature shaft for controlling the speed of the motor and preventing the signal from over-running its position; the contacts are in series with the motor and are shunted during a portion of the movement, so that the speed control does not become effective until just before the signal arm reaches the proceed position. It is a very simple arrangement resulting in quick and accurate action of the signal arm.

The motor is geared directly to the semaphore operating shaft and holds the signal in the clear position through the medium of a reactance which is cut in series with the motor by the action of the circuit breaker at the end of the clearing movement. The signal returns to the stop position by the action of gravity.

The direct gearing of the motor to the semaphore operating shaft and the holding of the signal in the clear position by the motor, renders the use of a slot or dash not unnecessary, and thereby eliminates these troublesome features. The circuit breaker is a complete unit and is connected directly to the operating shaft by means of segmental gears, and is provided with individually adjustable contacts for the control of 12 circuits including the local control of the signal.

All of the cars of the system are provided with 3 glass tubes connecting with the train air system. Each signal is provided with an auxiliary arm which is mechanically connected to and operated in unison with the single arm, and is so located that when the signal is in the stop position the tube on any car attempting to pass will strike against and be broken by the arm. The breaking of the tube results in a semi-service application of the brakes, which cannot be released until the broken tube is replaced; a limited supply of, and the strict accounting for tubes, forms a most effective check on the observance of signals.

Means are provided on each signal pole whereby in the event of any disarrangement of the signal system the auxiliary stop arm may be raised by hand for the passage of a car; this can be accomplished only by the insertion of a key in a lock provided for the purpose, which key cannot be removed until the arm has been restored to the normal position.

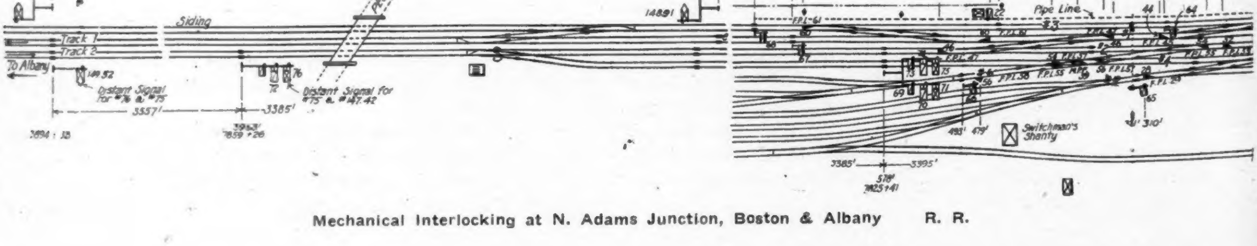
MECHANICAL INTERLOCKING AT NORTH ADAMS JCT., MASS.—Boston and Albany R. R.

The Boston and Albany R. R. recently put into service at Tower No. 55, North Adams Jct., Mass., a 76-lever S. & F. mechanical interlocking machine. There are 30 levers for 30 signals; 18 levers for 25 switches, 1 double slip, 1 movable point frog and 4 derails; 21 levers for 35 facing point locks; and 7 spare levers. The leadout consists of rocker shaft and vertical cranks.

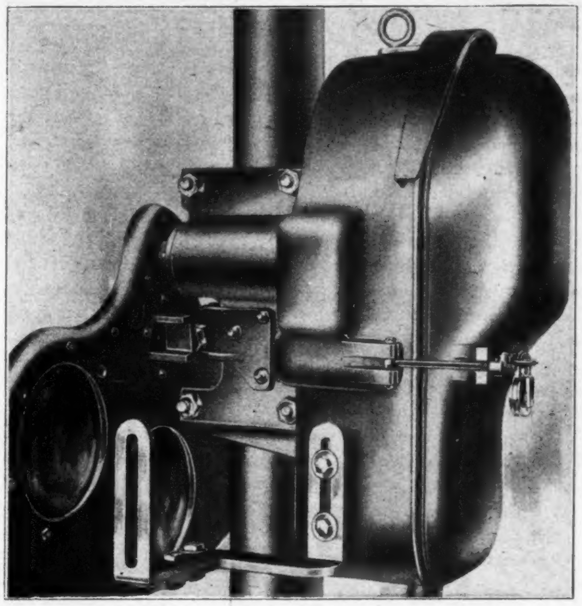
The track plan shown herewith, gives the complete layout of tracks and location of all functions within the interlocking. High speed derails are not used on any part of the interlocking. The only derails used are Hayes model 5, located on leads to protect main line tracks.

High home signals 2, 11, 70, 71, 72, 74, 75, and 76, are semi-automatic normal danger signals, of the "Hall style K," three position upper right hand quadrant type, operating to 90° for high speed, and to 45° for limited speed. Signals 4, 12, 69, and 73, are calling on signals, governing low speed movements. They are G. R. S. Co.'s type of mechanical signal, operating to 45° in the upper right hand quadrant. All the remaining signals on the plant, except the two high fixed blades, are also of the G. R. S. Co. make, operating the same as the calling on arms. All signals govern according to the following: Home signal No. 2, normal speed on track 1 as far as automatic signal 148.91; home signal No. 11, limited speed from "North Adams main" to track 1, via crossover 44 as far as automatic signal 148.91; home signal No. 70, limited speed from track 4 to track 2 via crossover 54 or 26 as far as automatic signal 147.42; home signal No. 71, normal speed on track 4 as far as automatic signal 147.44; home signal No. 72, limited speed from track 2 to track 4 via switch "S" as far as home signal 71; home signal No. 75; normal speed on track 2 as far as automatic signal 147.44; home signal No. 74, limited speed from track 2 to "North Adams main," via crossovers 46 and 44; home signal No. 76, normal speed on track 2 as far as home signal 75. Calling on signals govern all movements similar to the following: No. 73 slow speed on track 2 as far as automatic signal 147.42; or from track 2 to track 4 via crossover 30 as far as automatic signal 147.44; or from track 2 to track 1, via crossover 46 or 52; or from track 2 to track 10, via crossover 46 and switch 32, or, via crossovers 52 and 50 and switch 48, or from track 2 to North Adams "Old Main," via crossovers 46 and 50 or 52 and 50, or via crossovers 46 and 44 and switch 42, or via crossovers 46 and 44, switch 40 and crossover 38; or from track 2 to track 29, via crossovers 46 and 50 and switch 48, or via crossovers 52 and 50 and switch 48, or via crossovers 46 and 44 and switches 42 and 48; or from track 2 to "North Adams Main," via crossovers 46 and 44; or from track 2 to track "2 North," via crossovers 46 and 44 and switch 36; or from track 2 to track "1 North," via crossovers 46 and 42 and switch 40. All dwarf signals govern over all routes similar to the calling on signals described above.

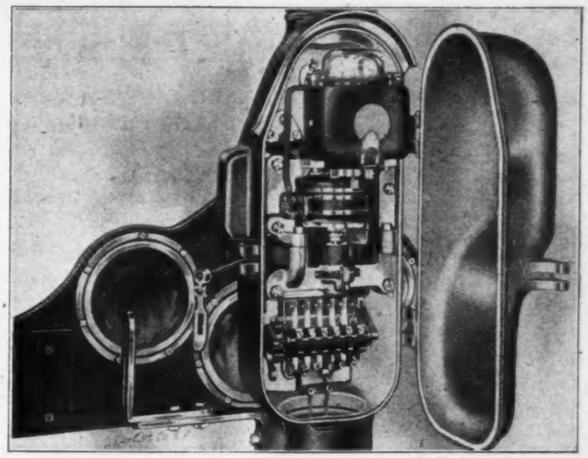
The signal department developed a track plan, scale 50′ = 1″, for this interlocking, showing all signal functions and tracks,



Mechanical Interlocking at N. Adams Junction, Boston & Albany R. R.



Side Clamp Case, 3-Position Top Post Style K Signal.



Style K Top Post, Three-Position Signal Mechanism.

upon which the routing of each signal is given in detail similar to the routing of several of the signals as given here. The plan is known as an opening plan.

The high home signals, as stated before, are the Hall Signal Co.'s Style K, the signal mechanisms being located at the top of the masts. The pictures shown herewith illustrate the method used to mount the mechanisms to the signal masts, and also show the mechanism itself; the motor, the hold clear magnets, and circuit controller.

All signals are electric lighted, 110-volt, 2-c. p. carbon lamps being used, with one lamp per blade. Night indications are; green for clear, yellow for caution, red for stop. Marker lights are used to designate interlocked signals from automatic signals.

The operating battery for power signals consists of 5 to 7 cells of storage battery of the lead type, manufactured by the National Storage Battery Co. The capacity is from 80 to 120 amp. hours. The charging current is 10 to 15 amps.

Track circuits are fed from the same type of storage battery, one cell per track section. The battery housing consists of concrete houses above ground.

Track relays are: G. R. S. Co.'s type, wound to the following resistances: 4-9-12 and 16 ohms. Line relays annunciators and indicators are also G. R. S., wound to 500 ohms resistance. Electric locks are G. R. S. model 2 style "B." Trailing release route locking is used, throughout the plant.

The following grades and sizes of wire are used, for conveying current, and connecting up apparatus: Bootlegs, No. 8 B. W. G. iron: leads from track No. 6 rubber covered copper: for shunt circuits, No. 8 rubber covered copper: for battery, No. 10 rubber covered copper: leads from line, No. 12 rubber covered copper: local wire No. 12 rubber covered copper, not including track and relay leads; tower wiring, No. 12 rubber covered copper. All wire ducts are wooden, above ground, except the ducts between charging switches and batteries, and to the electric locks on the interlocking machine which is iron conduit. This plant was designed and constructed under the supervision of F. E. Whitcomb, Signal Engineer of the Boston and Albany R. R., to whom we are indebted for the information and illustrations shown herein.

SIGNALING.

The Boston & Albany will install an all-electric interlocking plant of 80 levers and a mechanical plant of 60 levers at Worcester, Mass. The signals are of the upper quadrant type. On the Newton Highland Branch the clock work signals are to be replaced by normal danger three-position, upper quadrant semaphore signals operated by storage battery and lighted by electricity.

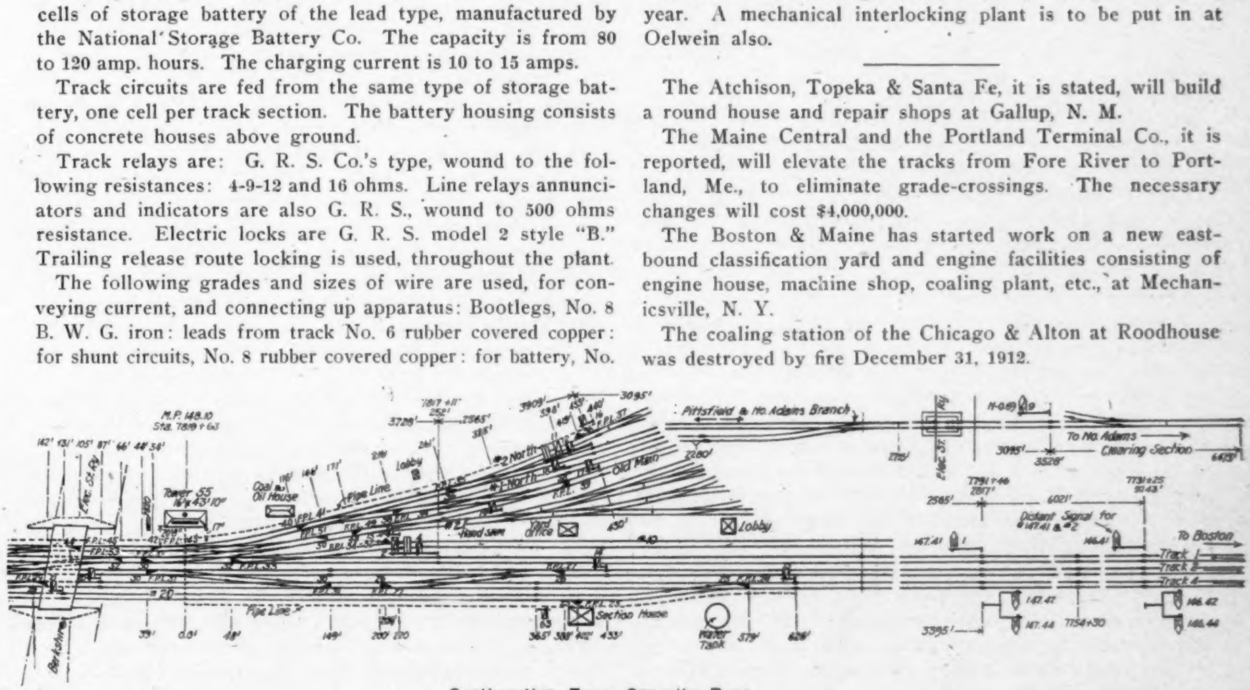
The Chicago Great Western is planning to put in an all electric interlocking at Somers, Ia., during the coming year. A mechanical interlocking plant is to be put in at Oelwein also.

The Atchison, Topeka & Santa Fe, it is stated, will build a round house and repair shops at Gallup, N. M.

The Maine Central and the Portland Terminal Co., it is reported, will elevate the tracks from Fore River to Portland, Me., to eliminate grade-crossings. The necessary changes will cost $4,000,000.

The Boston & Maine has started work on a new eastbound classification yard and engine facilities consisting of engine house, machine shop, coaling plant, etc., at Mechanicsville, N. Y.

The coaling station of the Chicago & Alton at Roodhouse was destroyed by fire December 31, 1912.



Continuation From Opposite Page.

The Maintenance of Way Department

EDUCATION FOR MAINTENANCE OF WAY MEN.

Editor *Railway Engineering*:—I have read with much interest the articles in the December number of *Railway Engineering and Maintenance of Way,* contributed by Mr. Andrew Palm, Roadmaster, W. P. Ry., on the subject "A Maintenance of Way Sermon."

It seems to be a hard matter for many of us to associate theory and practice, the technical and the practical; and I believe this holds true with railway men more than to any other class of employers and employes. We all know that experience is a good teacher, but observation and study are also good teachers; and when these three are combined, the knowledge thus gained is almost sure to be reflected in the subsequent success of the recipient. Education and railroading are two words that have been widely separated, but now they are getting closer together, and the time is coming when an educational department will be a recognized necessity, and will be an important department of a railroad organization.

I would like to state briefly what the educational bureau of the Central of Georgia Ry. is doing in an effort to supply instruction to employes in all branches of the service. The Bureau is established for the mutual benefit of the Company and the employes. All instruction is free of charge, and any employe, no matter where he may be located, may take advantage of the opportunity, as the work is handled by correspondence. Courses are specially prepared for nearly every branch of the service and are approved by the heads of departments interested.

While this article is intended to refer particularly to our track course for maintenance of way men, nevertheless, the same methods of conducting the work are used for the various other courses. The track course offered by the Educational Bureau consists of a series of papers covering in as practical a way as possible the various phases of track work. It comprises nine lessons, the subjects of which are shown below in the order in which they are furnished to the student:

Standard Track Tools.

Rules and Regulations of the Maintenance of Way Department.

Ballast.

Ties.

Rails and Fittings.

Maintenance of Roadway and Track.

Maintenance of Tunnels and Right-of-Way Fixtures.

Construction of New Line and New Second Track.

Turnouts, Crossovers, Crossings, Frogs, and Switches.

In addition to these regular papers, there is one on Section Foreman's accounting, one on Section Motor Cars, and one on the Time Table.

We urge on all track men the importance of mathematics, and endeavor to get them to take up this study along with the track course. Anyone who desires to study the engineering features can do after he has qualified on the necessary mathematics lessons. We are prepared to furnish special instruction to those who want to take this advanced study. We have some good books on maintenance of way work which we loan to employes to read. There are also two other courses of particular interest to men in the maintenance of way department, and these are our Concrete and Gas Engine Courses.

We have been very successful in interesting our maintenance of way men in the Track course; and the number of applications and letters of commendation indicate that this instruction is appreciated by them. The study is not compulsory, and very little effort has yet been made to get the men interested, other than by distributing in a general way our literature describing the various courses. Of course, the supervisors and roadmasters are co-operating very effectively on some of the districts, and this is shown by the large number of enrollments from these districts.

The Bureau has been in operation about nine months, and we have at the present time more than sixty per cent of all the section foremen on the entire system. On one Division we have seventy-five per cent of the foremen enrolled as students, and on another Division we have seventy-one per cent; while on some districts we have practically every foreman enrolled as a student. In addition to the foremen, we have general supervisors, and a large number of apprentice foremen, and white laborers.

This educational work is a very interesting side of railroading, and is growing more popular as the employes become better acquainted with its scope and true purpose and the spirit in which it is being carried on.

It is gratifying to note that railroad officials are beginning to realize that the employes deserve to be given an apportunity to prepare themselves for better and more efficient service, which will ultimately fit them for the increased responsibilities in the more remunerative positions.

(Signed) D C. Boy,
Assistant Chief, Educational Bureau, Central of Georgia Ry.

LABOR ARTICLES.

Editor *Railway Engineering:* I have been interested for some time in the discussion of the subject of the labor problem in your publication, and I know some points to be facts that have not yet been published. Maintenance conditions are at a low ebb, even worse than when track labor was paid as low as 80 cents in some localities. I have worked at that rate, from sun up to sun down, for the simple reason the farm hands got, in the same locality, only from $12 to $15 per month for same time worked, and other public or corporation labor got very little more. Now, section labor in these same localities gets from $1 to $1.25 per day for 10 hours. Farm labor receives about $35 per month, with board added. Public and corporation laborers, other than section men, get from $1.50 to $3 per day, with less time actually worked.

Now, is it any wonder that we get the worst labor? Sometimes we get a good man to go to work on the section, but he only stays a short time, or until he can get a better job. And while he is working for us we have other poor men working along with him that never do good work, and the good man's work only makes a solid spot among the poor places the poor men work. I know there are lots of critics, even in the maintenance department, that say that poor laborers should be discharged, but suppose we did that, what kind of men would take their places? Green men only at the price paid on sections, and the very best we can do is to keep the poor ones that cannot get or hold a job where better wages are paid and do the best we can with them. Often we make out with men that would be getting too much if they were only paid 10 cents per day.

The hours worked on sections are too long. A man can loaf along and put in ten or twelve hours per day. But if he puts vim into his labor he is tired in four hours and needs one hour's rest. Then he can work hard for another four hours and needs more rest. It is the labor that is done with a vim that does the most good. Did anybody ever see a tie well tamped that was tamped slow and easy? Then is it any wonder it takes so many men on sections to keep trains going? And even then the track is rough.

I think we should have less men, but better men on sections and pay them wages which can compete with wages paid generally in each section of the country. We should work only eight hours in twenty-four, except in emergencies. It takes just as good labor to do good track work as it does to do good work at anything else, and we cannot expect to get good labor and hold it unless we pay a fair price for it.

I will admit there are a great many poor section foremen that are worth very little pay. I have followed up a good many foremen in the twenty-four years that I have been a section foreman and I have found some work that the railway would have been money ahead to have paid them twice their wages to leave the section alone and to have had a good man to do the work.

A competent foreman can save twice his wages as compared with a careless, don't-care foreman. A roadmaster cannot remedy these things until maintenance-of-way men are paid enough so that poor laborers and foremen can be done away with and good ones put in their places at a price that will hold them with their jobs.

J. E. Caurville.

FAIR TREATMENT FOR SECTION FORCES.

C. Clay, Roadmaster A. T. & S. F.

Did it every occur to you that in railroad work there is no happy medium? There is an accelerating or a retarding influence in progress, a forward or a retrograde movement; never is anything at a standstill. There may be short periods during which certain things appear to be at a stand, but these periods are never of long duration, and conditions must improve or they will have a tendency to slip back. Did you ever stop to study out your labor on this basis? Presumably not, if so then you found that while the motive power and appliances had improved and also the track to a certain extent, the track forces had suffered a severe setback with reference to their efficiency. Why is this? Possibly an analysis of the situation will enlighten us. Starting with the earlier railroading; men used in those days were farmers to a small extent or farm laborers. They turned to railroading as a more lucrative method of earning a living. After this the emigrants arriving found that it was as good a means of livelihood as any and a large number drifted to it. You naturally ask if they drifted to it then, why do they not now? The reason is that the cities were not so large then and the men went direct to the railroads, as there were not the opportunities in the city as there are now, and man somehow prefers to congregate in numbers, the tendency being always toward the cities rather than to the country.

Here is the explanation of the matter: We are still getting the emigrants, but not the class that we received before, for the simple reason that the city gets them before they reach the paints where the railroad can use them. In making a shipment of men from a city you will find that the percentage of the number who are steady men is very small, the remainder and majority being habitual boomers who would not stay any place and merely use this as a method of getting from one city to another. The track force when composed of the better class of emigrants was practically on a level, that is, they were receiving the same class of men as were leaving them and the rate of pay remained stationary. The necessary impetus toward an upward tendency in effectiveness was a raise of pay proportionate to the other branches of service on a railroad. This impetus was lacking, or never given, with a result that as no level of that description can be maintained, a backward tendency set in, the railways receiving a poorer and a poorer class of laborers until we have reached the level of the present day. There is one evil which was overlooked when the labor question was practically on a standstill; that was that you cannot coax a man from the city to the country. Give a man a section house of four to six rooms, plenty of room for a garden and two dollars a day to work as laborer on a section and you will find that you cannot coax him from the city where he is earning a dollar a day and living in two rooms. There are reasons for this, the majority of which are too obvious to mention here. The following are important: The difficulty of obtaining provisions, medical aid in time of sickness and lack of companionship. If any reader has lived on the prairies four miles from the nearest habitation and eighteen miles from the nearest town he will readily recognize what these features mean.

The man does not feel it as bad as his wife will. I mention this advisedly because your single man need not enter into this calculation at all. He will not stay more than a month away from town, if he stays that long. But for the sake of example we will take a married man with a wife and children located at a flag station, where there is a small store, a few farmers living around and the laborers. Is that foreman likely to be a contented man? Are the laborers likely to be contented? No they are not. They want some place where they can send the children to school, they want to live where they will meet other people, especially the women. In fact, as I have heard numbers of them say, they want to live. There are hundreds of locations through this country that are not so bright as the one pictured. Of necessity they must be placed at points where they will best serve the railroad, and here is one: Picture to yourself the desolation of a Canadian winter, a side track, a section house for the foreman and family, a grain elevator occasionally in use, and then only after the grain has been threshed, possibly for a month, a small store, nearest residence or farm four miles, two trains a week and the town sixteen miles away. At the section house there is a tie hut which houses two doukhobors possibly, anywhere from ten to fifty miles away from their families, and you have a prospect that is not alluring, except to a recluse. I know, because I have lived in such a place. Yet there are other places worse than this, but as I have not lived in worse I refrain from mentioning them.

But apart from this you have sections where the foremen and men are located at points where they are in touch with a number of inhabitants. Taking as the happy medium a place as follows: A store, several residences, occupied farms all around, and a section house, such places as you will meet through Missouri and Kansas. The foreman and laborers are still a long way from the necessaries of life, or rather the luxuries of life, which might be classed as necessities. One of the women is taken ill; possibly they are able to telephone for a doctor, but by the time he has made a visit of at least ten miles for the round trip, his fee will not be small. One or two such happenings and a man is seriously considering moving to a place where he is in closer touch with the rest of his fellow beings. You receive a request for a pass, a family wants to go to town. Do you look at it as so many passes issued or that your man is some distance from town and wishes to obtain something that he cannot obtain where he lives, except through a mail order? Are *you* in favor of buying things that you cannot see? I do not think so. Maybe you find a man who is contented to live in such a place and it happens to be a flag station. One evening he wishes to mail an important letter, takes his hand car, the men volunteering their services at no cost to the company, goes possibly five miles to where he can mail it and is seen. The matter being reported to you, what is your action? Presumably he is discharged for using a hand car on other than company business. Were the circumstances considered? It has always been so easy to discipline track forces, decisions were never appealed, and in some places it has been overdone. Please understand that this does not refer to all places, because I could name places where track forces are favored. But, nevertheless, keeping to the middle West as the medium between the teeming life of the East and the soli-

tudes of the West, it is not a fact that over discipline and restriction have caused a large number of good track men to leave the railroad and go to the city? Once in the city they stay there; it is easy to obtain medical aid when needed without having to pay a large fee, you can see everything you buy before you buy it and do not overlook the fact that influence of the woman has a great deal to do with men leaving the section; on the section, while their husbands are at work, intercourse with their kind is limited; in the city they can go out visiting, and even if they just see people and don't visit them they do not notice the fact that their circle is almost as limited as on the section where they saw no one. The fact of their intercourse being limited is unnoticed because they see people. I have often seen people living in tenements who were perfectly contented with one room and a dollar a day, whereas in the country they had four rooms and with their produce from the garden their income was easily equivalent to what three dollars a day would buy in the city.

I have never seen this point discussed before and it is a hard one to combat. One way is to give your men all the concessions possible in the way of permitting them to visit a town a reasonable number of times during the year. Naturally this will differ in accordance with locality. If you treat your foreman in a considerate manner I am under the impression that he will treat you so. In only one or two cases have I noticed where the opposite was the case; then, of course, it is necessary to restrict the man. Your foremen are on a twenty hour a day basis, practically speaking. If you permit them to go to the city or town for a day or so, seven or eight times a year and your foreman understands this is a concession and that his pay will continue, he will so arrange his work that his men will not have to touch any vital part of the track while his is away. And the company will lose nothing, for the men will be doing necessary work; the foreman will see to that. In the event that anything happens that one or all the men cannot attend to, then they can put out flags and get the foreman from the next section. But in all of my experience I have never known this to happen once.

There should be a relief foreman on each division and he should relieve each foreman in turn for at least two weeks in every year. This is going to mean an extra outlay, but it will work for effectiveness. Two weeks for a year's service should be the rule, the time they are permitted to be away from their sections on full pay being pro-rated according to this limit, and length of service. Say you have twenty-five sections. In this case the expense for fifty weeks, average salary $60.00 per month, would make an expense of $751.92 (considering the two weeks' salary of the man on vacation) to offset the following. Your foreman would have a thorough rest and a change, and the best point is that a railroad man never gets very far from a railroad, and during his holiday it is practically certain that he would pick up some new wrinkles that he would see and which would never come to his attention were he to stay on the section. It gives him a chance to see what some other person is doing and it is certain that he will learn something.

There is another way this might be handled. Suppose your sections are each five miles in length, have each of the adjoining men take a half of the section from which the foreman was absent for the time that he was away. It could be easily arranged but the amount saved on this latter method would be lost by your foremen who were at work having half as much more to do than before. The greater the mileage per foreman the less effective he will become. It is really to better purpose to spend the $700 and permit this to be offset by the increased knowledge in your foreman by travel and the rest he will receive. A man suffers by remaining in one place without change, and his efficiency must naturally be retarded by his remaining on the same basis. There is no question but that the track has improved during the last few years, that is, in the appliances and material taken as a whole. It is still an open question as to whether there is any improvement in the individual pieces such as rail, etc., but our track forces have not kept step, naturally they must improve or in time it will retard improvement in the Mechanical and Transportation Departments, as they cannot continue to improve on the present basis without the track being improved to meet them.

Irrespective of the class of material placed in track, your track forces will have to be improved to enable the track to be improved. The railroads shy at increased pay, but it will inevitably come to that, although the matter will be held in abeyance as long as possible. I have shown how increased efficiency might be obtained at a slight cost and at the same time give a little consideration to the section foreman who needs it. Of course it would be impossible to extend the courtesy of a holiday to a laborer because he is paid by the hour and for every hour he works. But we can consider him by not restricting him when he wishes to go anywhere on a pass with certain limits. Any other conman, and I am firmly convinced that where you consider greater effectiveness in relation to their work will result.

ALLEVIATING 1912'S LABOR DIFFICULTIES.

J. J. Morgan, Storekeeper.

The establishing of the various gangs for the season of 1912 has already given opportunity for improvement in its different branches. The physical energy required in the launching of these gangs must, in order to secure the best results, be guided by an equivalent amount of mental energy, good sound common sense, and a little foresight.

Although June 21st marked the first day of summer, the weather conditions during the past few weeks gave very little indication of this glorious season's approach. The weather has certainly been remarkably cool, ideal for extra gang work, and those who have been fortunate enough to secure sufficient men to permit the starting of their extra gangs have every reason to congratulate themselves. Much time has been lost during this ideal weather on account of being unable to secure laborers.

Laborers are usually secured through labor agents, and at the present time with considerable difficulty and delay in some sections of the country, due to the great demand for this class of men. This matter, however, should be given attention at the time of the dismissal of gangs each year, instead of waiting until ready to start operations, it being so difficult to secure men at that time on account of the demand being almost universal. The men should be persuaded as much as possible (through interpreters if necessary) to return to their present location at the opening of the coming season. Some may say this is easier said than done. In fact, it would not be necessary if the proper conditions prevailed. The first problem presenting itself and to which the laborers usually give their first attention on their arrival at a certain point, is the condition of the cars, buildings, etc., in which they are to be housed during their stay here. An undesirable impression on the part of the laborers in this regard would in all probability result in their changing locations at the first opportunity and seeking employment elsewhere. Therefore, considerable attention should be given to seeing that these cars, etc., are in proper condition for habitation by these men, who at least deserve a decent place for shelter. Arrangements should be made to have these cars, etc., cleaned every morning, a man to be assigned to this work, and inspected by the foreman once a week, he in turn to report result of inspection to the supervisor, roadmaster, or whoever his superior may be. To do this would entail but a very short time, and this spirit of cleanliness, although practiced by but

a small percentage of this class, would eventually make them more desirous of returning each year, would facilitate the securing of experienced men to a greater extent, thereby securing better services than from the ordinary wandering laborers.

The best results, in my opinion, are obtained by treating the laborers considerately, but at the same time exercising a spirit of authority over them, so as to make them feel that you mean business; in other words, maintain a happy medium with the men. The foreman who has the good will of an entire gang can accomplish infinitely more than the foreman whom the men feel is "driving them," for when they are so inclined, it is very difficult to get satisfactory services out of them. The words of David Garrick seem to fit in appropriately here: "A fellow-feeling makes one wondrous kind."

The clerical work involved in connection with establishing these gangs also plays an important part in the game and has also afforded opportunity for improvement in this line. In looking after this branch of the work, one problem presents itself most conspicuously. The various Public Service commissions, State and Railroad reports, as well as the pension system in operation on the New York Central Lines, make it necessary to determine the correct records of certain men from time to time. In order to secure the men's records, it simply stands to reason that it is necessary to have their correct names each time. At present, when a man changes from one gang to another, the name as shown by one foreman, in nearly every instance, differs more or less from that given by the other, most of the difficulty being in the names of Italians. The foreman, of course, asks the Italian's name, then spells it the way he happens to catch the man's pronunciation, and when the laborer is transferred to another gang the result is that the foreman in charge of that gang very often spells the name in such a way as to lead one to believe that he is an entirely different man, and in the majority of cases it would be at best a matter of guess work as to the correct identity of the man, especially where there is a large number of men to be looked after. There surely must be some remedy found for this situation sooner or later, and the suggestion that I wish to offer, although not altogether practical, would help the matter along until such a time as someone would devise some means to completely remedy the present situation. The system which I would recommend is to furnish each foreman with a supply of cards printed in the following manner:

Location ....

Full Name ....
Date Employed ....
Date of Leaving..................................
Signed ....
Foreman.

The foreman would have one of these cards made out for each man in his particular gang, strict attention being given to the legibility of same, allowing the men to retain these cards. In the event of a man changing locations, he should be instructed to turn over the card to the foreman employing him, and if he should fail to do so, the foreman should request the card. All the foremen should be thoroughly instructed in regard to this matter on the establishing of the system, they in turn giving the laborers the necessary information. The foreman, on receiving a card from a previously employed laborer, should forward same to the roadmaster, etc., for his information in compiling records, new cards being given to the men in each instance of their changing gangs, the foremen being very particular to copy the names exactly as they appeared on the previous cards. I should consider it a very good plan to secure different views on this matter, as it is a problem, which, if not remedied soon, is sure to cause trouble in the near future.

WESTERN AIR DUMP CARS.

C. L. Van Auken, Sr.

I noticed an article in the December number of *Railway Engineering* in regard to the efficiency and labor-saving qualities of a "Jordan Spreader" with which I fully agree. Your many readers who are interested in devices for quick and cheap handling of filling in railway work will be interested in a description of work which came under the writer's supervision recently.

We were building the fill for a large yard. The area to be filled consisted of a swamp, the larger part of which was covered with from 6 inches to 3 feet of water. As it was next to impossible to lay track through the swamp, the filling was done by commencing on the side and throwing the track to the edge of the dump as the work progressed. The fill averaged about 6 feet. The estimate called for 500,000 yards, but was too low. The material used was sand. We started in with Haskel and Barker side dump cars, using a Marion side plow. We did not have a spreader, and had to get along with an old-fashioned Bull Dozer.

The H. & B. cars were heavy, making the maintenance of the dump and pit track expensive. And do the best we could, there would be an occasional derailment, causing delay and adding to the cost of yardage.

We were later furnished with 12 yard Western Air Dump Cars, and a great many of our troubles ended with their advent. They were light and consequently easy on the track, simple and easy to operate and required very little repairing. The haul was short, the average being about one mile. The material, as I previously stated, was sand. We operated two trains, using 20 cars to each train.

Six "dump men" attended to the unloading, from 2¼ to 5 minutes being required to dump a train. As soon as the loads were dumped the train was pulled back and the sand "dozed" down, the Bull Dozer being coupled onto the rear of the train. The locomotive engineer having applied the air and dumped the cars, he reverses the air, and as the train moves back the cars are righted, the dump men hooking the holding chains. The Bull Dozer is uncoupled and the train is ready to proceed to the pit. The whole process takes less time than it does to stretch the cable to unload a train of H. & B. cars when using a lidgerwood unloader. The yardage was increased about one-third by the use of the Western air dump cars. The two trains, using either 18 or 20 cars each, were easily able to take care of all the filling a 70-ton Bucyrus shovel could load working in a 30-foot face sand bank.

SUGGESTIONS FOR HOLDING LABORERS.

J. T. Bowser, Chief Clerk, M. W. Department.

The labor question in general and the question of unskilled labor in particular, has become, within the last decade, a question which requires the serious, intelligent consideration of every man who has to do with the employment and handling of men.

The extensive construction, not only in railroad work, but in all other lines, has created a demand for unskilled labor that even the enormous immigration to America from foreign countries has been unable to supply.

What will apply to unskilled labor in general will also apply to track labor, and the questions arise:

How are efficient track laborers to be secured?

How are they to be retained?

Is the average laborer employed on track work an efficient track man?

Is it possible to get a fair day's work from him?

What special methods may be used to keep the amount of work accomplished up to the standard, and how may the amount be increased?

Does the foreman who drives his men accomplish more than he who treats his men more considerately?

What is of the greatest importance in getting track work done?

Speaking in general, track forces may be divided into three classes—native laborers, viz., men who live along the line of road; negro floaters, in the South, for extra gang use chiefly; non-English-speaking laborers.

Of these classes, as a rule, the best results are to be obtained from the native laborers, and when possible section forces, at least, should be drawn from this class.

The fact that the homes of the majority of these men are located along the line of road, they have families to support, and other responsibilities, insures more regularity in work and tends to keep them permanently in the service. This permanency is of prime importance as experience, of course, makes for efficiency.

In the South good results are obtained from negroes of this class. These men may be attracted and retained in a number of ways. The following suggestions may be of value:

(1) The provision of cottages, at a nominal rental, on sections where the country is sparsely settled and where houses of this class are not to be obtained in the community.

(2) Allow foremen to board men who may live too far from line of road to permit going and coming each day. Foremen to be protected for this board by means of stoppage on pay rolls.

(3) An arrangement for making stoppages on pay roll for protection of local merchants so that laborers may purchase the necessities of life where they are paid monthly. The average laborer lives "from hand to mouth" and has no credit. Very often for this reason he cannot work where wages are paid monthly.

(4) An arrangement for weekly payrolls in manufacturing districts and at other points where the majority of laborers are paid weekly. These weekly pay rolls may be handled by local agents.

(5) Free transportation, in moderation of course, over Company's own line of road. Foreign transportation for laborers is not to be recommended as a rule. To prevent abuse of this privilege a rule should be put into effect that passes will be granted only on request of foreman and approval of road supervisor or other official directly in charge of foremen. Then only at stated intervals, for instance, one pass per man per year.

(6) Provision of card transportation where train service will permit the daily transportation of laborers from districts where labor is more plentiful to city yards, or sections where labor is scarce.

(7) Extra compensation, time and one-half for overtime made at accidents, washouts and in other emergencies where men are often required to work several hours in excess of regular working hours under trying conditions. Time and one-half for regular work done after working hours is not to be recommended.

(8) Provision of opportunity for advancement to position of foreman or higher, to men of intelligence and ambition.

(9) Wages paid laborers should be kept in proportion to wages paid the same class of labor along the road.

For extra gangs the best labor is usually the young men from along the line who may be obtained by offering wages slightly in advance of regular section rates, and by furnishing camp cars or other accommodations for eating and sleeping. These men should board themselves, a good plan being to allow them to run their own commissary in the charge of foreman, dividing the expense according to the number of meals served. Foremen on these gangs should not be allowed to board these men as there is always the tendency on the part of the foreman to make it a moneymaking affair, thus increasing the cost of board per man and consequently decreasing the number of efficient men that may be obtained.

In handling negro floaters on extra gangs on southern roads the most satisfactory arrangement is for the railroad to board and feed them, the board to be a part of their wages. They cannot be depended upon to run their own commissary satisfactorily. In this case railroad companies should furnish camp cars, stoves and utensils, cook and groceries, and also bedding. A very satisfactory arrangement for purchase of supplies where the number of gangs employed will not justify the organization of a regular commissary store room, is to buy on competitive bids based on the estimated amount of supplies used per month. Prices quoted on these bids should hold good for thirty days, or the month for which the bids are submitted, regardless of the market.

Also a system of accounting should be put into effect by which the cost per meal may be accurately computed. The cost per meal can thus be kept at a very low figure.

It is *not* a good plan to allow the foremen on those gangs to run the commissaries on the gangs, as unscrupulous foremen would take advantage of the illiteracy of these men for their personal profit.

Men may be obtained for these gangs either by labor agent or by sending a reliable member of the gang, of the bellwether type, to cities along the line of road. Often these gangs are kept full by the reputation of the foreman. These floaters who drift all over the south all know by hearsay or from personal experience the foreman from whom they receive fair but firm treatment, and foremen of this type experience but little trouble in keeping a full gang at all times.

The type of labor agent above mentioned may be found in all southern cities. They are usually negroes who make a business of collecting men for contractors and railroads, delivering the men at cars or camp. Arrangements are easily made by which they will deliver these men to gangs for one dollar per head, payments being made by making deductions from the time due laborers, no payment being made for men who do not go to work. Precautions should be taken, however, to prevent the misuse of passes by these parties.

An arrangement by which these men may be supplied with tobacco, overalls, etc., will aid materially in keeping them satisfied where they are paid monthly. Local merchants are usually glad to furnish these supplies if provision is made by which they are protected from loss by stoppage on pay roll.

Non-English-speaking laborers in general are to be pro-

cured either through regularly licensed labor agencies or through interpreters or laborers on the gangs. The wages paid largely govern the available supply of laborers of this class.

The quality of labor available for track work varies greatly with the locality. Cases are not unusual where the laborers available in one locality may be excellent track men while at points within less than a hundred miles they will be almost worthless, but generally speaking, and excepting the very sparsely settled districts, men are to be found along the line of road who make fair section men.

As to quality of labor available for extra gangs; the average negro extra gang laborer is a good track man. These men are as a rule floaters and acquire a fair working knowledge of work of all kinds. The greatest difficulty with these men is that they do not stay longer than thirty days with one gang on an average.

The quality of the non-English-speaking laborer varies, on southern roads, with the season. In winter when the greater portion of work on the northern and northwestern roads is suspended good men of this class can be obtained. But, with the opening of spring and summer work, on account of the rates paid by these roads for summer extra gang work being as a rule much higher than the prevailing rates for extra gang labor on southern roads, these men cannot be held.

At present it is difficult to get out of the average track laborer what would have been called a good day's work ten or fifteen years ago. This is due, to some extent, to the much greater demand for labor. To be discharged is not fraught with the terror of the times when work was scarce.

There is also a dissatisfaction which does not tend to make a man work harder, due to the wage increases received in recent years by organized labor in trades where work is much easier than in track work, these increases being quite out of proportion to the increases received by unskilled labor during the same period.

Among the very lowest class of labor, the negroes of the south chiefly, there is a marked decrease in efficiency due to habits indulged in, manner of living and disease. Cigarettes, whisky and cocaine are working havoc with this class. And this combined with their manner of living weakens and makes them incapable of performing a day's work and makes them easy victims of diseases so prevalent among them.

For increasing the amount of work accomplished the section motor car is coming into general use. These cars enable the length of sections to be slightly increased and the men get to the work fresh instead of half tired out by possibly a five or six-mile pull on a hand car. The saving in time is, however, the largest item to be considered.

Attention should be given to the quality and condition of tools used by the men, as the average laborer will not only work better but of course will accomplish more with good tools. Economy in tools is often false economy.

On construction work or on other work where two or more gangs may be employed the stimulation of rivalry between gangs has been too long used to increase the amount of work done, to be more than mentioned. A branch of this is the system of giving premiums to best sections each year. The rivalry stimulated in this manner often extends to the laborers themselves with the desired results.

The treatment received by laborers from foremen doubtless has as much to do with the laborers which may be obtained and the amount and quality of work done as any other one thing. In general, the foreman who treats his men fairly but is also firm with them, gets better results than the foreman who is harsh and drives his men hard. It is practically impossible for a foreman who is unnecessarily harsh and hard, to keep a full gang, and the man who is lax in discipline, familiar with his men and easy going accomplishes very little.

The best attitude for a foreman to laborers is one of impartial, impersonal authority. What he will lose through not having the personal regard of his men will be more than regained by the additional respect for himself and his instructions.

Good foremen are of vital importance in getting track work done. With even the best of labor, a thoroughly efficient gang may be practically useless under a foreman who is lax or has not the experience or executive ability to work them to advantage.

Conditions permitting, it is well to furnish steady employment to at least a few men on each gang the year around. This will keep these men better satisfied; they will be more likely to stay in the service when the demand for labor is at its greatest if they feel assured that they will be kept at work when forces are reduced. This will also insure a few experienced men when regular work opens up and forces are increased. These men will be of no small advantage to foremen handling the larger summer gangs of less experienced men.

There is no doubt but that it is best to keep the same men in the service as long as they are efficient workmen and to do this and to insure a supply of efficient men rates paid track men should be kept in proportion to rates paid other labor of this class in the same locality.

In handling extra gangs a good practice is, where practicable, to keep each gang on the same class of work through the entire season such as rail gangs, ditching gangs, ballasting gangs, etc. Thus no time is lost working down to full efficiency as when changes in class of work are made.

It must always be borne in mind that though good labor be procured and retained, without the proper supervision it cannot be used to best advantage. Given efficient foremen, the labor problem is half solved.

The Central of New Jersey, it is reported, is considering plans for a bridge to be built on Main street in Ashley, Pa.

The Chicago & Eastern Illinois is building a $40,000 freight warehouse at Evansville, Ind., to replace one destroyed by fire.

The Chicago, Milwaukee & St. Paul is said to have ordered 840 tons of bridge material from the Wisconsin Bridge & Iron Co.

The Chicago, Milwaukee & Puget Sound is making plans for a new passenger station to be built on a site 280 ft. square at Tacoma, Wash.

The Chicago, Rock Island & Pacific, it is said, will erect a depot at Iowa Falls, Ia. Improvements will also be made to its warehouse and offices. The total cost of the work to be about $80,000.

The Gulf, Colorado & Santa Fe has awarded a contract for a new passenger station of brick and concrete construction to be built at Marietta, Okla.

The Illinois Central, it is said, will enlarge its shops and freight houses at East St. Louis, Ill.

The Kansas City Terminal, it is reported, will soon start construction on viaducts across Brooklyn avenue, Tracy avenue and Olive street in Kansas City, Mo.

The Lake Shore & Michigan Southern is said to have issued specifications for about 2,000 tons of bridge steel for a new lift bridge to be erected in Chicago, Ill.

The Louisville & Nashville, it is stated, will construct a creosoting plant at Guthrie, Ky., at a cost of $150,000.

The Pacific Fruit Express Co., it is reported, will build an ice and cold storage plant at Nampa, Ida., at an estimated cost of $110,000.

The St. Louis, Arkansas & Pacific, it is said, will construct 4 steel bridges, the spans being 3,300, 1,400, 1,200 and 900 ft., respectively.

PILE DRIVER USED ON THE FANAMA CANAL.

History shows that pile driving began with a man and maul, the ancient Egyptians apparently being among the first as in many other engineering matters, to apply this combination to coax nature into their service for the general good. From this earliest form the drop hammer pile driver has been developed, operating with a hoist line and driven by steam, gas or electricity; recent years have seen the invention of the steam hammer driver which rests directly upon the top of the pile to be driven.

These improvements have increased the rapidity of the operations for forcing the pile into the ground. To keep pace with this progress especially in railroad work, it is necessary that the driver should not only pick up and place the pile quickly in position but should also as a whole move as quickly from point to point for driving straight or batter piles either ahead or on the sides, and upon completion of the work should easily house the outstanding apparatus for transportation over the road.

The accompanying illustrations show an unusual development of the pile driver for use on the Panama Canal. It consists of a self propelling car carrying a self propelled truck which in turn supports a self rotating structure for driving piles at various angles and in any position, and so designed that all pile driver ways and equipment can be quickly lowered to within standard railroad clearances for transportation.

Fig. 1 shows the leads swung to drive piles on a batter, the movement of the leads being controlled by a hand wheel and screw. The maximum side batter at which piles can be driven is three inches per foot. Piles are hauled by an independent driven whip hoist. The front reach in position shown is nineteen feet forward of the leading truck wheels.

This pile driver, of the Browning type, is steam driven, and self propelling at the rate of about 6 miles per hour. It is capable of making 3 revolutions per minute and the truck is of the 8 wheel type, the distance from center pin to leads being 30 feet.

One axle of each truck is driven by a spur gear and a pinion, which is pulled out of mesh when coupled in a train for running over the road. On the pinion shafts are located bevel gears which mesh with bevel pinions on a horizontal traveling shaft extending through from truck to truck.

In order that the machine may propel itself while the upper base is at any point of its travel this shaft is splined and carries a bevel gear. This gear is made to slide along the horizontal travel shaft and has in it a key which rides in the spline of the shaft, which is supported from the center of the auxiliary truck by a steel casting. This bevel gear meshes with a pinion in the vertical traveling shaft passing up through the center pin of the auxiliary truck.

The auxiliary truck is broad gage and carries the rotating structure or pile driver proper, consisting of the engines boiler, leads, hammer, etc. This auxiliary truck travels back and forth on the lower truck a distance of 17 feet 3 inches by means of an endless cable attached to a drum at one end of the car, operated by a hand lever.

The boiler is 60 inches in diameter, 8 feet high and is located on the structural frame at the rear, being sufficiently large to furnish steam for operating both the machinery and the steam driver. A heavy 4 in. six-ply oval wire wound steam hose supplies steam from the boiler to hammer. The ways or leaders are two channels 65 feet in length carried by a swing frame and supported by means of a large pin connected at the top. This allows the ways to be set for batter piles.

Batter piles can be driven ahead or at the side. Side piles can be driven up to a maximum batter of 3 inches per foot, and piles in front can be given any desired batter. The angle for batter piles is controlled by a hand operated screw, working a nut attached to the leader framing at some distance below the suspension point.

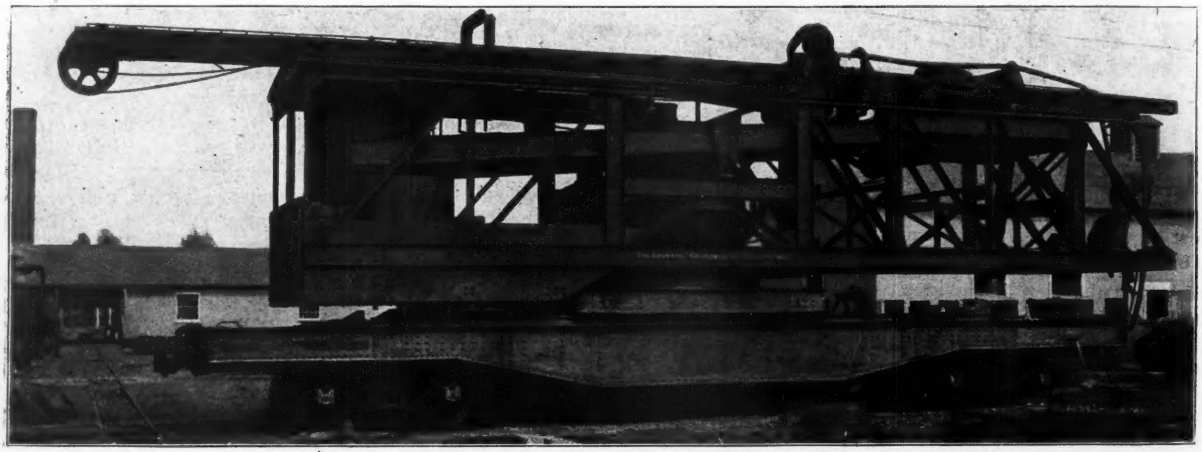


Fig. 2. Pile Driver Arranged for Transportation.

The swing frame is supported by rigidly braced short radius arms below and by long arms at the upper end. This provides for lowering the ways into a horizontal position over the car for transportation. The long arms are hinged at the ways and extend back to the operating machinery where they are connected by racks, pinions, worm gear, jaw clutch and spur gears to the engine shaft. The racks are riveted to the ways and roll on the shrouding of the pinions. These shroudings form flanges for supporting the racks and arms.

The steam hammer used weighs 10,150 pounds. Its length is 12½ feet and the diameter of cylinder is 13½ inches normal with a stroke of 42 inches, the weight of the striking part being 5,000 pounds. The construction between ways gives 20 inches between jaws of hammer and a width of jaw of 8¼ inches.

There is a double drum equipment used, one drum for handling the steam hammer and the other with its clutch forming a whip hoist for hauling the piles into position. The machine will handle piles 22 inches butt diameter 90 feet long and drive them 28 feet from the center of the track and 19 feet forward of the leading wheels of the front truck.

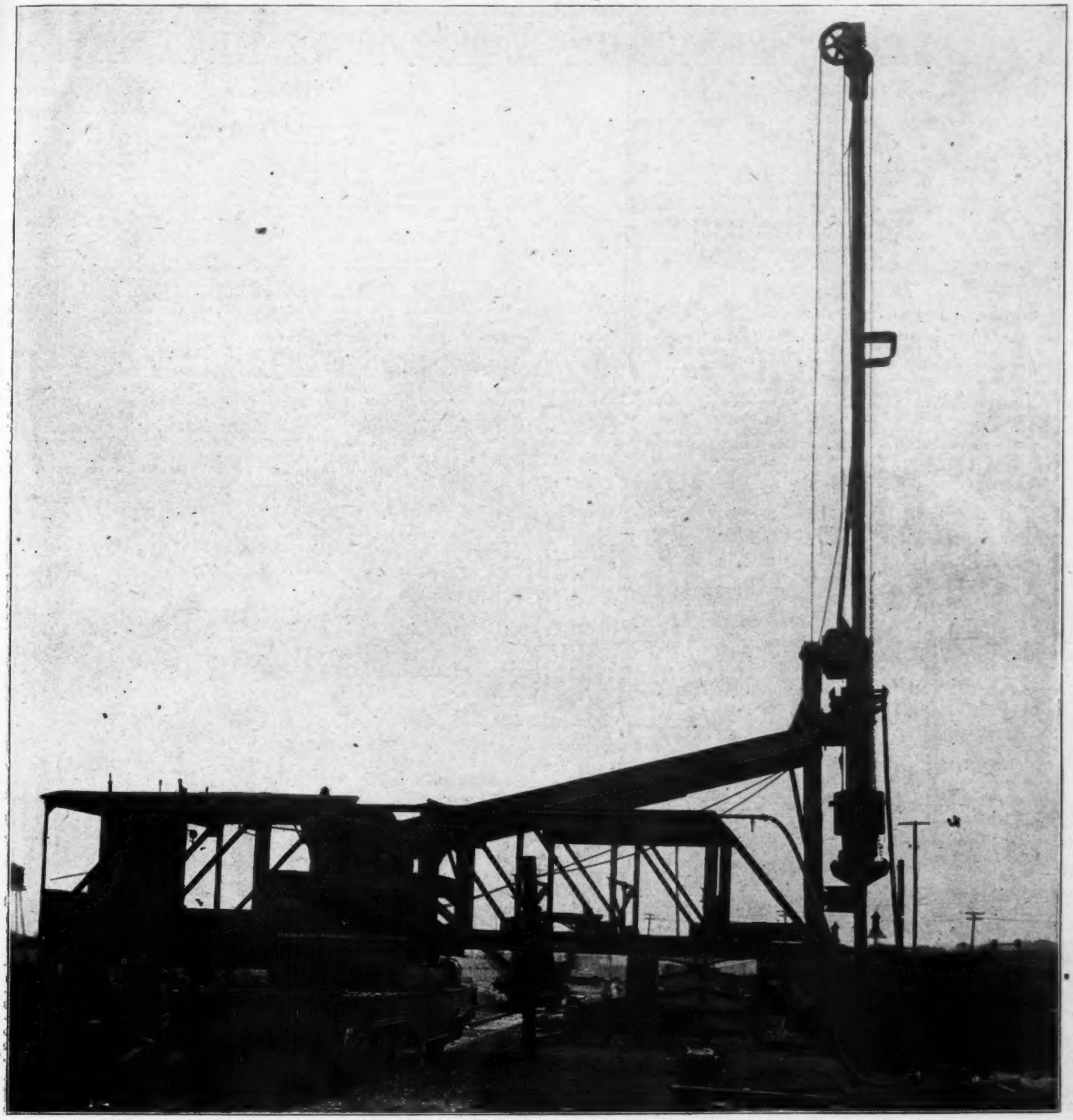


Fig. 1. Pile Driver Ready for Driving.

The height of the machine properly locked in position for transportation is 16 feet over all. The shipping weight is 150,400 pounds.

Fig. 2 shows the machine lowering the hammer and leads to a horizontal position over the outfit by means of a frame made of two I-beams with racks on the underside. The operation of raising or lowering requires about one minute and a half.

The Chicago, Indiana & Southern, it is said, recently suffered the loss by fire of its freight house at Kankakee, Ill. The entire contents and records, totalling over $100,000 in value, are said to have been destroyed.

The Chicago, Rock Island & Pacific, it is reported, is having plans made for a new freight depot at Wichita, Kan., at an estimated cost of $80,000.

The Chicago, Milwaukee & St. Paul has completed the large steel bridge across the Chehalis river, near Montesano, Wash. The machinery for the draw will be installed at once and the roadbed will be completed.

The Chippewa Valley, it is reported, will erect a six-story building in Eau Claire, Wis.

The Gulf, Colorado & Santa Fe has awarded a contract to the American Construction Co. or the construction of the new Union station and general office at Galveston, Tex. The building will be of steel and concrete construction, six stories in height, and will cost approximately $500,000. It will include a waiting room 62 ft. x 100 ft.

Jarvis Hunt, of Chicago, Ill., is said to be the architect of a union station that will be erected at Dallas, Tex., at a cost of approximately $5,000,000.

Recent Engineering and Maintenance of Way Patents

RAILWAY SIGNALING SYSTEM.

1,047,917—C. J. Coleman, assignor to the Union Switch & Signal Co., New York.

In a railway signaling system, a pair of conductors, means for sectionalizing the same to form a series of successive circuits, a break in one of the conductors of each circuit, sources of signal controlling current each arranged to apply its electro-motive-force across one of the breaks, a second break in one of the conductors of each circuit, and electro-responsive devices each arranged to receive the electro-motive-force across one of the latter breaks.

CROSS TIE.

1,047,928—B. F. Fink, Huntingdon, Pa.

A composite tie including a flat metallic reinforcing bar mounted on edge, blocks mounted at their centers upon the upper edge of the bar and integral with the bar, webs integral with and connecting the sides of the bar and the bottoms of the blocks, rail fastening flanges extending throughout the lengths of the blocks and along the outer edges thereof, there being fastener receiving openings within the blocks adjacent their inner edges and at opposite sides of the bar, and a concrete body of the same length as the bar and having its upper surface flush with the upper edge of the bar, said bar being centrally located in the body and the blocks being extended throughout the width of the body.

DUMP CAR.

1,048,312—F. S. Ingoldsby assignor to the Ingoldsby Automatic Car Co., St. Louis, Mo.

A car having a continuous cross sill located at the center of the car and dividing the car into hoppers at each side thereof, and a longitudinal sill extending from bolster to bolster and dividing at the center, the divided ends being supported by the cross sill, the longitudinal sill being of ridge form, and draft members connected to the bolster and to the under side of the ridge.

RAILWAY RAIL FASTENER.

1,048,398—George Edick, Albuquerque, N. M.

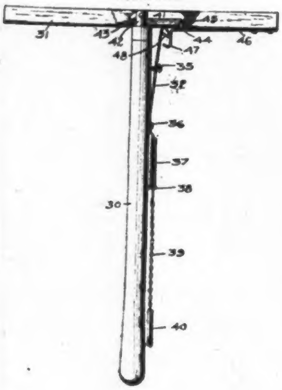
In a railway rail fastener, the combination of a cross tie having a rail supporting surface and vertical openings on either side of the supporting surface, keys including rail engaging bit portions, and shank portions adapted for insertion into the openings, gravity locking dogs on the shanks adapted to engage with one side wall of the openings, and filling blocks adapted to be inserted into the openings and bear on the locking dogs.

BASCULE BRIDGE.

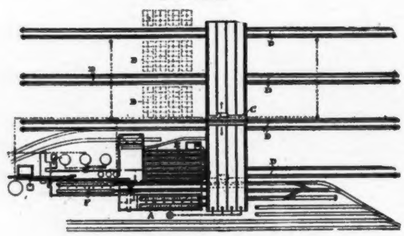
1,048,440—F. J. Benni, St. Petersburg, Russia.

In combination with the rolling part of a bascule bridge of the type herein specified, a counterweight movably adapted to bear upon the short end of the bridge, a pair of parallel links pivotally connected to the top of the counterweight, a similar pair of parallel links pivotally connected to the bottom of the counterweight, and a guiding frame connected with the short end of the bridge, having two parallel uprights, to which the pairs of parallel links are connected, and having a pair of horizontal parallel bars guided by supports mounted on the bridge.

1,047,243



1,047 404



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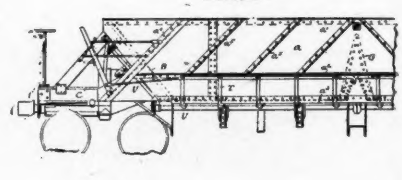

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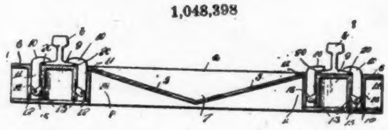

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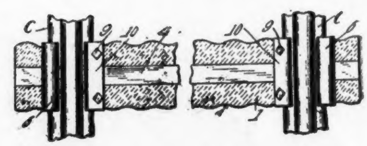


MEANS FOR OPERATING BASCULE BRIDGES.

1,047,950—C. L. Keller, assignor to Scherzer Rolling Lift Bridge Co., Chicago.

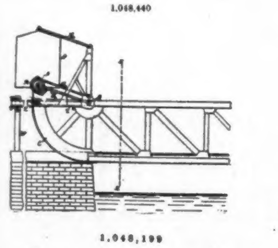
A bascule bridge comprising a swinging leaf and operating mechanism for raising and lowering the leaf, the bridge structure embracing also at its shore end a stationary part and a swinging part, the latter pivotally connected to the stationary part and to the swinging leaf, the operating mechanism being principally located on the side of the stationary bridge structure part, remote from the swinging leaf and embracing a curved rack that is fixed rigidly to one of the structure parts and a pinion that is rotatively mounted on the other of the structure parts and meshing with the rack.

RAILWAY CROSS TIE.

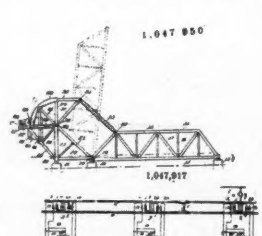
1,048,199—C. B. Nichols, Springfield, Ill.

In a composite tie, an angle bar bent to form internally flanged pockets and a channel between the pockets; in combination with blocks supported on the flanges of the pockets and a filler occupying the channel between the pockets.

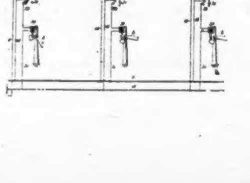
1,048,440



1,047 950



1,047,917



1,048,199

METHOD OF WOOD PRESERVATION.

1,047,404—W. F. Goltra, Cleveland, O.

The method of preparing railway ties to receive a liquid preservative consisting first in boiling the ties in live steam until the natural juices are expelled; then air drying in the open for a season; then gaining and boring the ties to prepare bearing surfaces for rails and holes for spikes, thereby permitting a thorough impregnation at points where ties are machined; then drying the ties in an oven until perfectly dried through and at the same time heating them to a receptive temperature for the preservative solution and finally impregnating the ties.

FLASH LIGHT APPARATUS.

1,047,243—F. Klein, New York, N. Y.

In a flash light apparatus, the combination with a pan and a supporting rod or handle therefor; of a hammer pivotally secured to the pan, the firing end of the hammer being inside the pan and the other end of the hammer extending below the bottom of the pan; a trigger slidably mounted upon the rod or handle; a spring member one end of which is secured to the bottom of the pan and the other end of which is provided with means adapted to engage the the trigger and be depressed thereby, the spring member being adapted when released by the trigger to spring upward and operate the hammer; and means adapted to automatically reset the mechanism after the same has been operated.

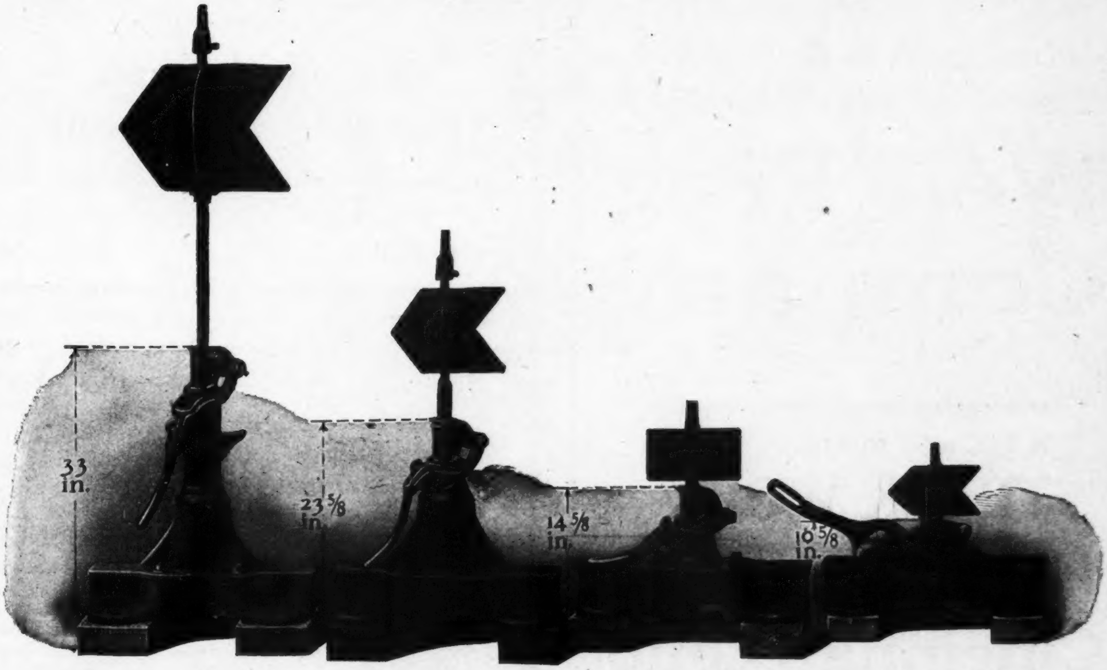
The Tennessee, Kentucky & Northern, it is reported, will soon enter Nashville, Tenn. Engineers are now at work surveying for the new line.

The Lorain, it is reported, will complete a line from Lorain, Ohio, to connect with the Pennsylvania at Custaloga, Ohio.

The Newton, Kansas & Nebraska, it is stated, has agreed upon the terms of a contract with Michael Cassidy, Oklahoma City, Okla., in which the latter will build the line from Newton to Canton, Kan., 30 miles.

The New York Central & Hudson has awarded the contract to the Walsh-Kahl Construction Co., Davenport, Iowa, for track laying north of Poughkeepsie, N. Y.

R A M A P O



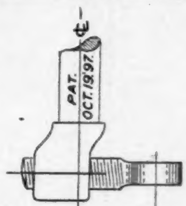
STYLE No. 17 STYLE No. 18 STYLE No. 19 STYLE No. 20

RAMAPO PATENT SAFETY SWITCH STANDS

1. POSITIVE THROW.—Ramapo Safety Switch Stands are rigid for hand operation. The operator raises the handle, thereby releasing the spindle from the automatic mechanism, then throws the switch, but cannot lower the handle or relock switch, unless the points are fully thrown.
2. AUTOMATIC SAFETY FEATURES.—A train or car can trail through a switch when set wrong locked with a Ramapo Safety Switch Stand, without breaking the switch points or injuring the switch stand. The first pair of wheels forces the switch points open compressing springs in the switch stand, and when points are half way thrown the springs snap the points the rest of the way. The stand is left locked in new position, just as if thrown by hand and is again ready for either hand or automatic operation.
3. ADJUSTABLE FEATURES.—All Ramapo Safety Switch Stands are furnished with adjustable throw and adjustable moving rods, unless otherwise ordered. Adjustable switch rods are not required as either switch point can be adjusted. The throw can always be adjusted to suit that of any switch, one-half turn of the eye bolt crank affecting the throw one-twelfth of an inch. See table of crank adjustments below. The distance of stand from switch can be readily adjusted with the adjustable moving rod without moving the stand on the ties.

CRANK ADJUSTMENTS FOR RAMAPO SAFETY SWITCH STANDS

THROW OF STAND	"A"	THROW OF STAND	"A"
3 1/2"	2 15/32"	4 1/4"	3"
3 5/8"	2 9/16"	4 3/8"	3 3/32"
3 3/4"	2 21/32"	4 1/2"	3 3/16"
3 7/8"	2 3/4"	4 5/8"	3 9/32"
4"	2 27/32"	4 3/4"	3 11/32"
4 1/8"	2 15/16"	4 7/8"	3 7/16"
4 1/4"	3"	5"	3 17/32"



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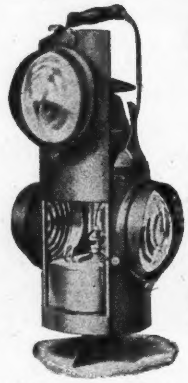

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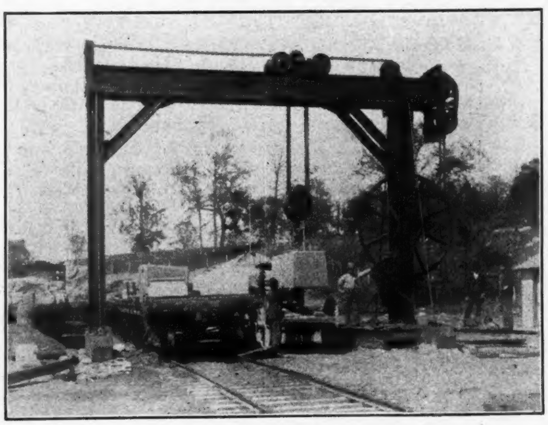

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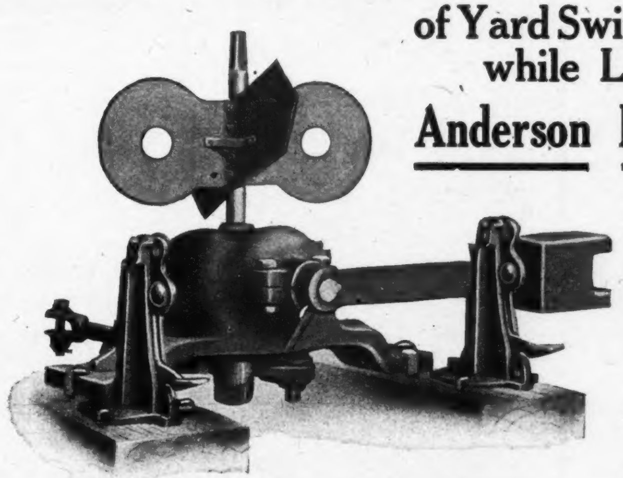
$16\frac{2}{3}$ CENTS Maximum Maintenance Cost of Yard Switches that are Run Through while Latched if you use the

Anderson Economy Switch Stand



This stand for yard switches, is provided with a special 3 way crank arm made of malleable iron. This 3 way crank arm is designed that when switch is run through, one of the arms to which the switch is connected will shear off, without damage, to any part of the switch mechanism.

The switch can be quickly placed in order by connecting the rod to one of the other arms. When the three arms are destroyed a new three way crank can be applied. These are furnished at 50 cents each. This feature is not new.

Over 30,000 Economy switch stands with this special 3 way crank, in service on many railroads.

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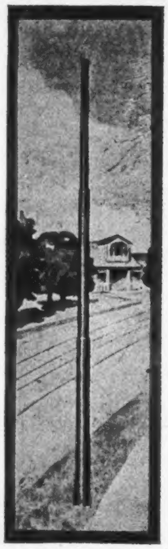

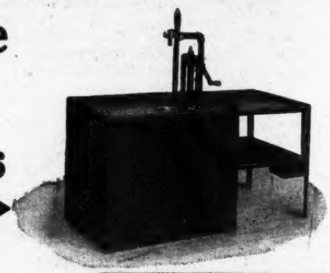

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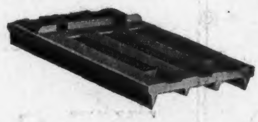

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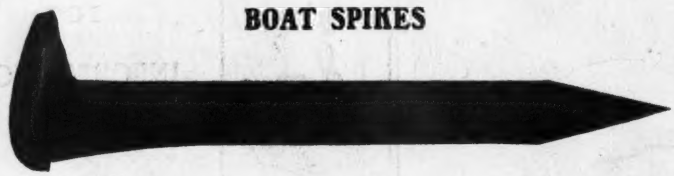
HARRIMAN PLATE

BOAT SPIKES

Standard and Special Railroad Spikes



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